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(54) **SWITCHING BETWEEN INTERNAL AND EXTERNAL ANTENNAS**

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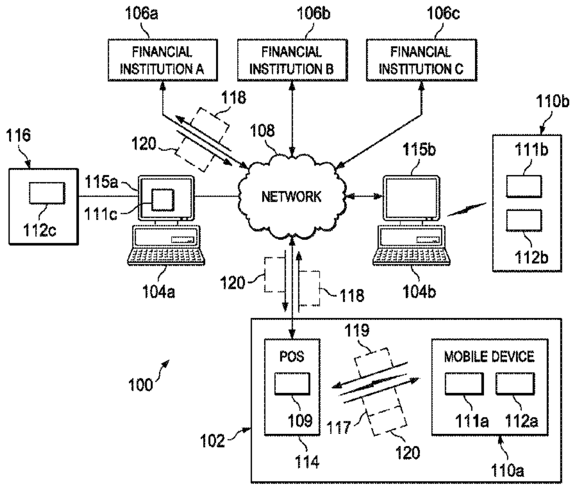
(57) **ABSTRACT**

The present disclosure is directed to a system and method for switching between internal and external antennas. In some implementations, a system includes an antenna, a connector, and a housing. The antenna is configured to communicate wirelessly transactions with transaction terminals. The connector is connected to the antenna and configured to connect a transaction card to the antenna in response to at least insertion in the housing. The housing enclosing at least a portion of the antenna and at least a portion of the connector and including one or more elements that form an opening for receiving the transaction card. In addition, the housing is substantially rectangular and includes a first portion with a first thickness and a second portion with a second thickness different from the first thickness and at least the thickness of the transaction card.

15 Claims, 22 Drawing Sheets



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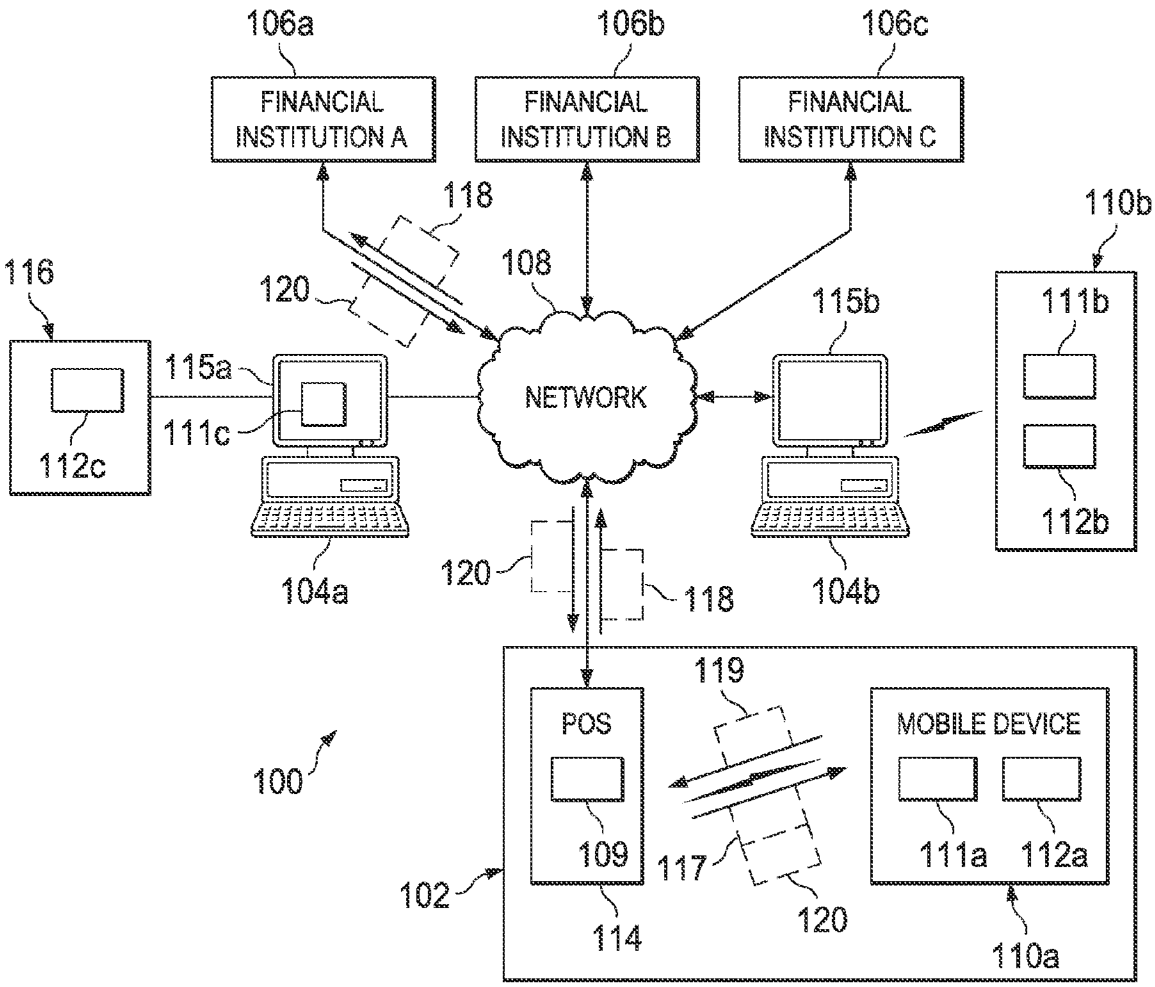
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106b
106c
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FINANCIAL INSTITUTION B
FINANCIAL INSTITUTION C
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120
108
110b
116
115b
111b
115a
NETWORK
111c
112c
112b
104a
120
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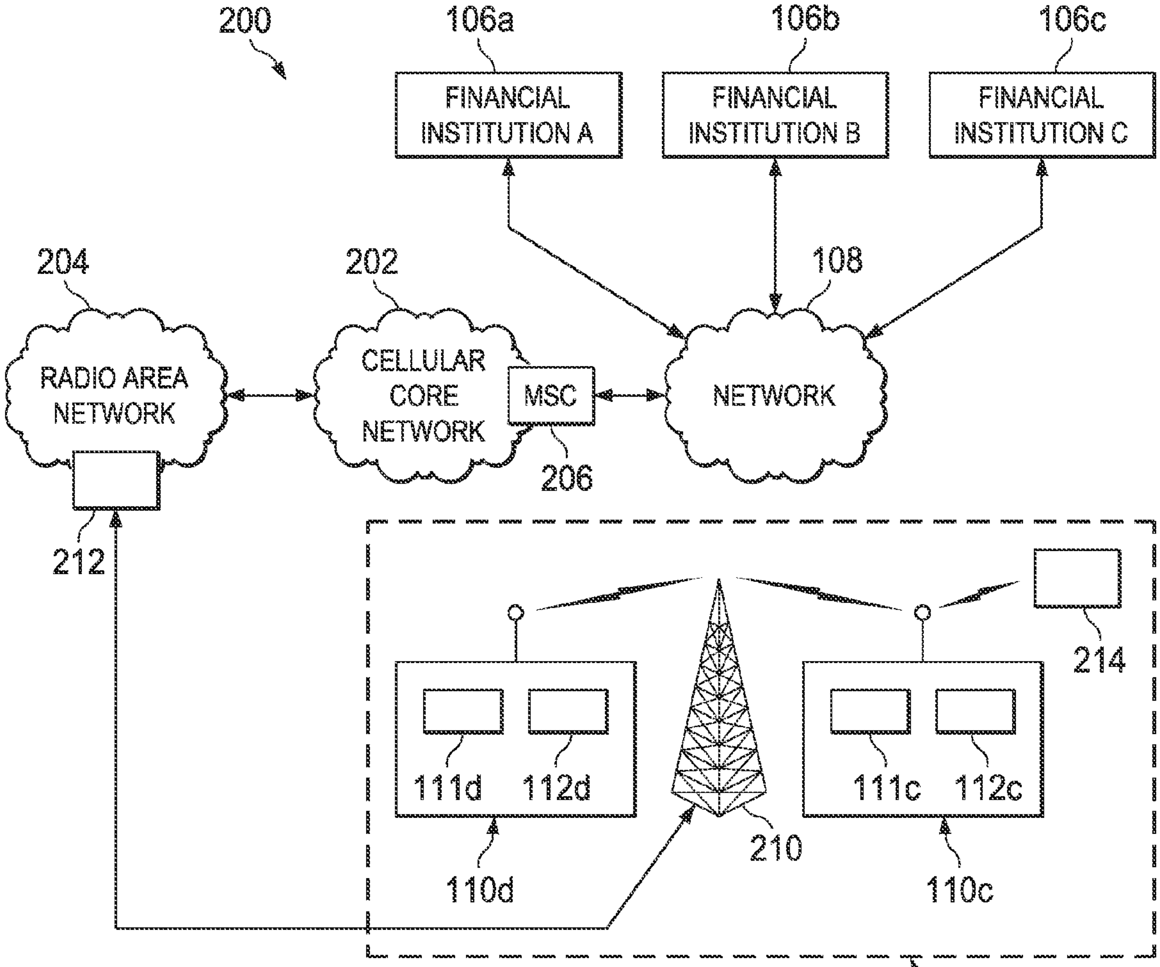
104b
119
POS
MOBILE DEVICE
100
109
117
111a
112a
102
114
120
110a

FIG. 1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106c
FINANCIAL INSTITUTION C
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202
CELLULAR CORE NETWORK
MSC
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108
NETWORK
212
214
111d
112d
110d
210
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112c
110c
208

FIG. 2

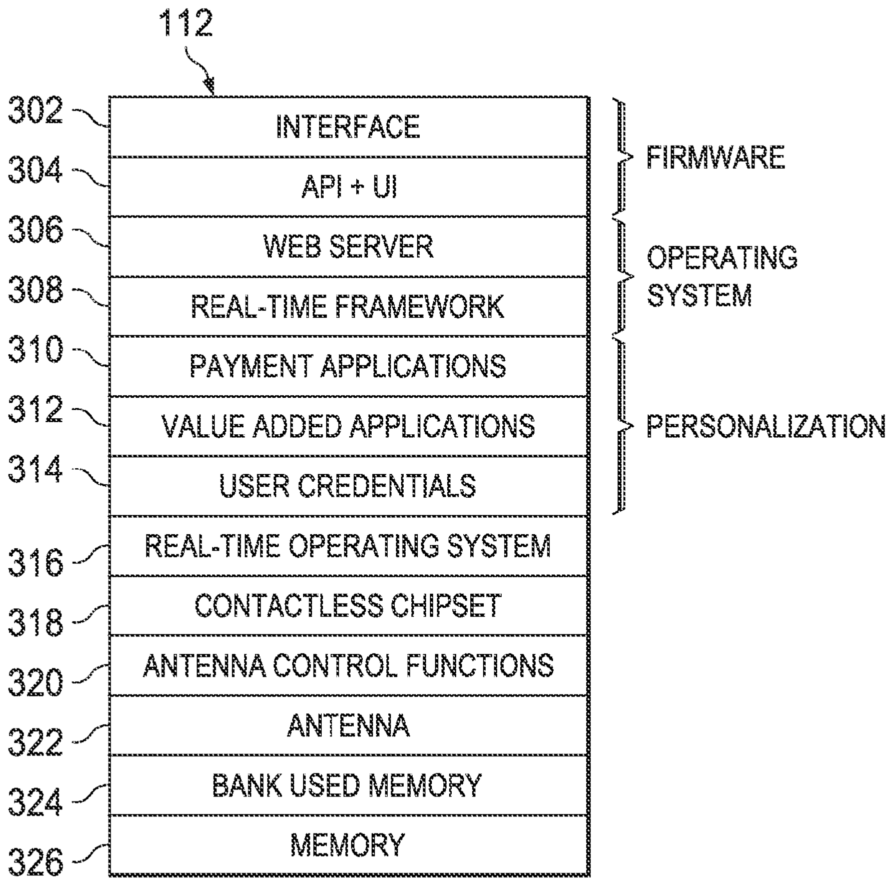

112
302
INTERFACE
304
API + UI
FIRMWARE
306
WEB SERVER
308
REAL-TIME FRAMEWORK
OPERATING SYSTEM
310
PAYMENT APPLICATIONS
312
VALUE ADDED APPLICATIONS
PERSONALIZATION
314
USER CREDENTIALS
316
REAL-TIME OPERATING SYSTEM
318
CONTACTLESS CHIPSET
320
ANTENNA CONTROL FUNCTIONS
322
ANTENNA
324
BANK USED MEMORY
326
MEMORY

FIG. 3

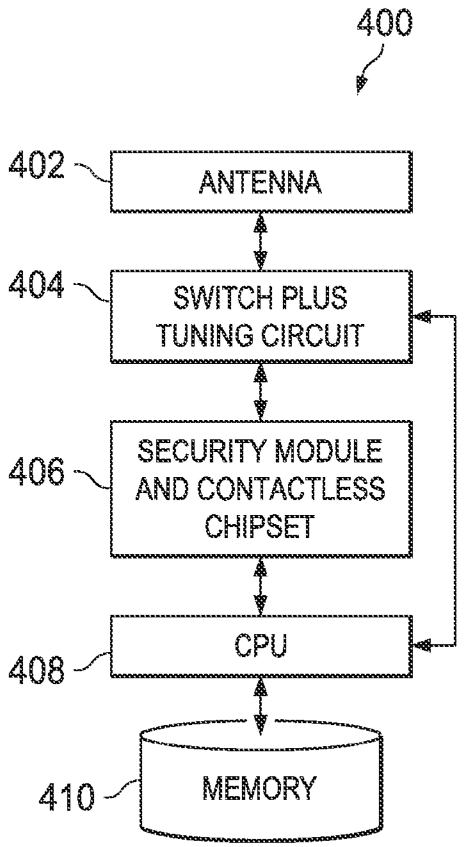

400
402
ANTENNA
404
SWITCH PLUS TUNING CIRCUIT
406
SECURITY MODULE AND CONTACTLESS CHIPSET
408
CPU
410
MEMORY

FIG. 4

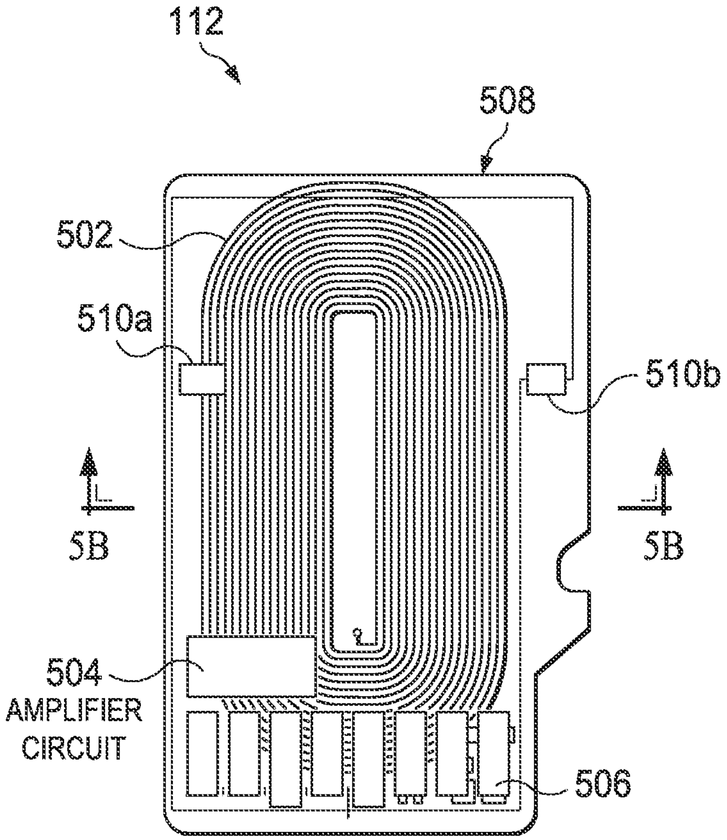
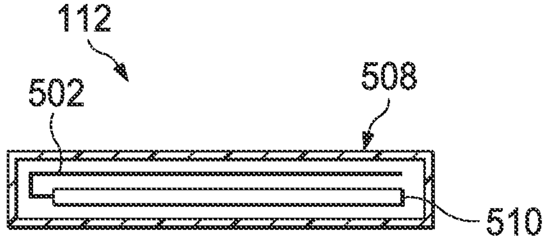

112
508
502
510a
510b
5B
5B
504
AMPLIFIER CIRCUIT
506

FIG. 5A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502
508
510

FIG. 5B

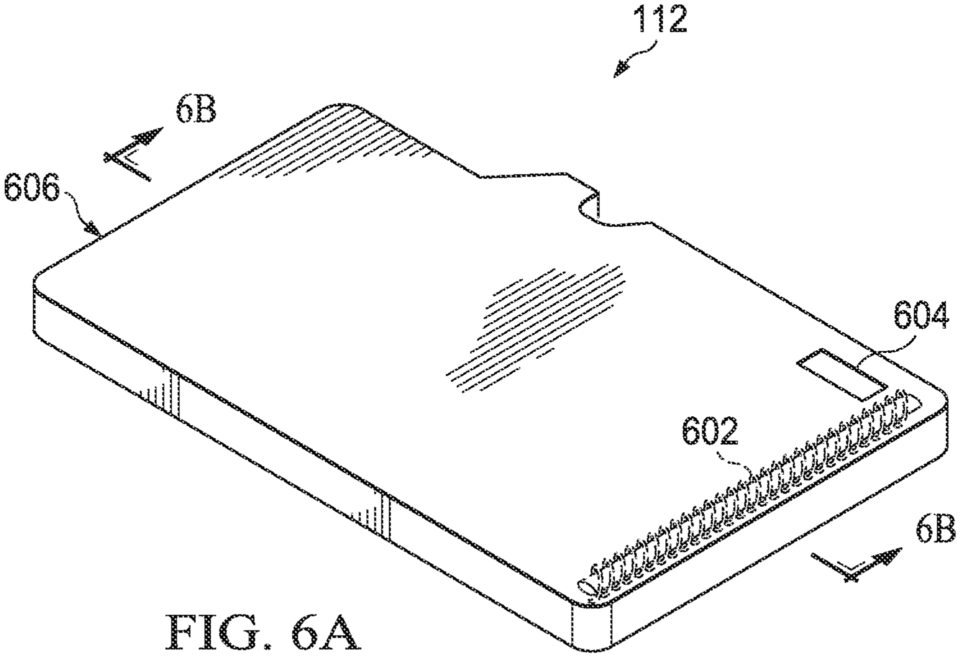

FIG. 6A

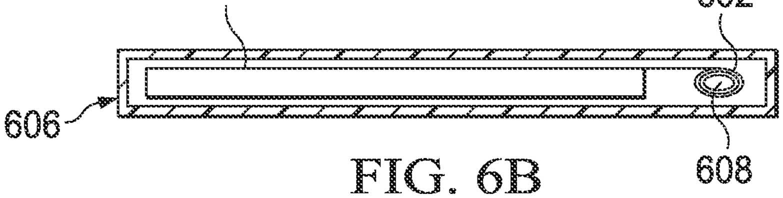

FIG. 6B

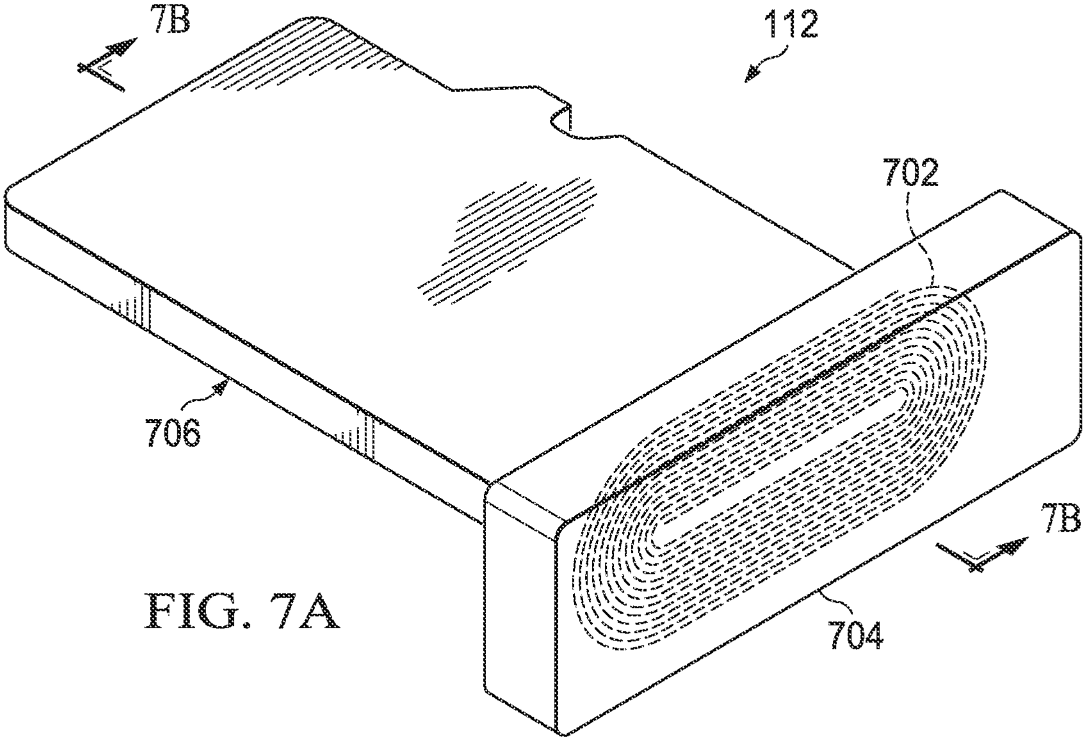

FIG. 7A

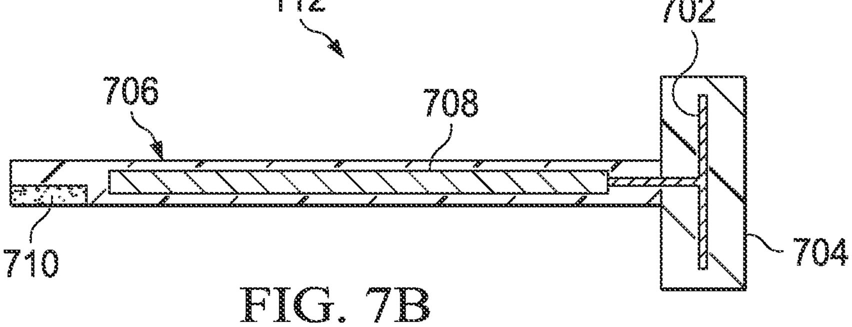

FIG. 7B

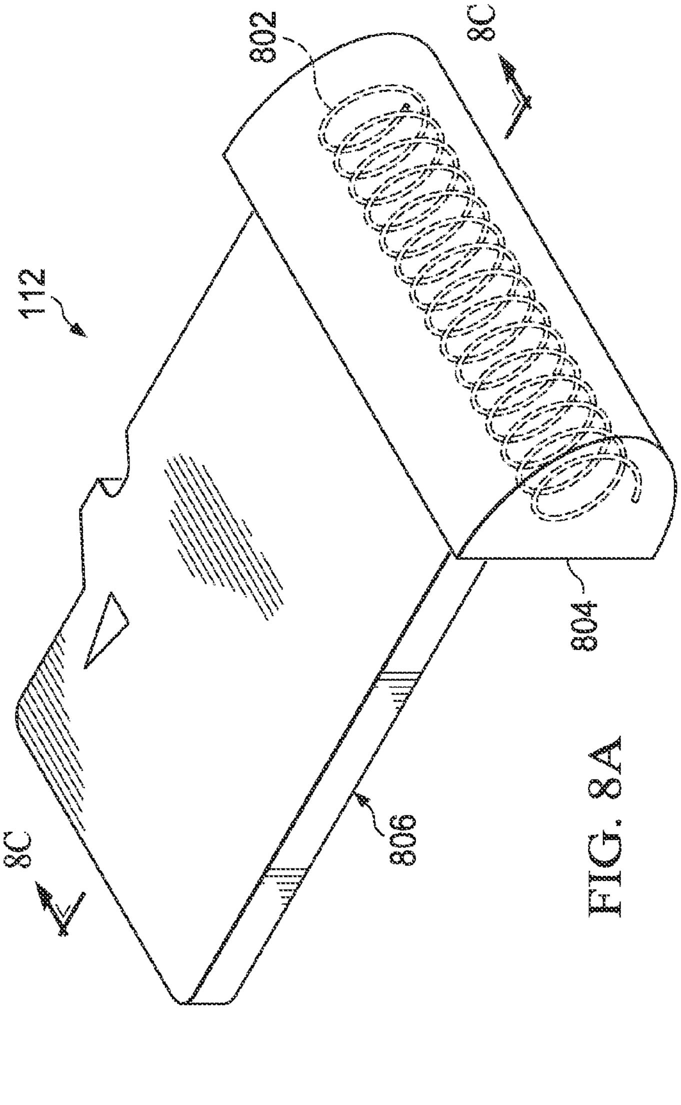

FIG. 8A

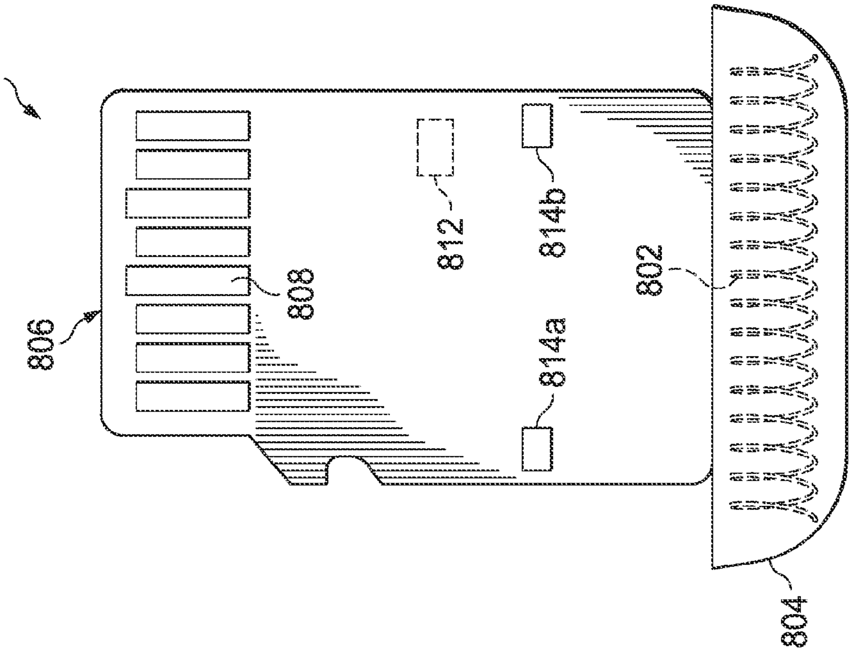

FIG. 8B

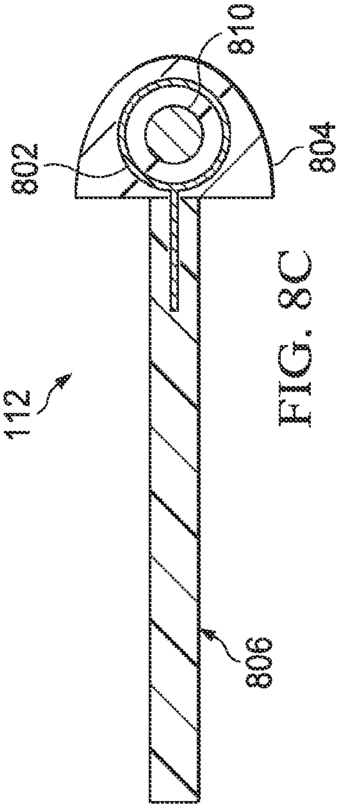

FIG. 8C

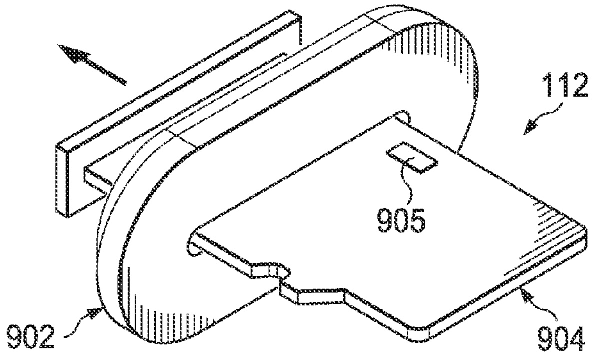

FIG. 9A

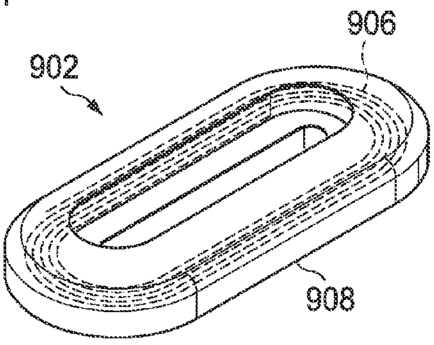

FIG. 9B

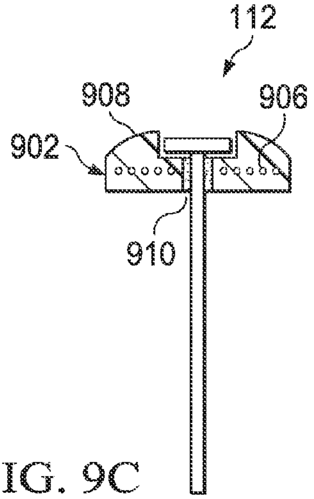

FIG. 9C

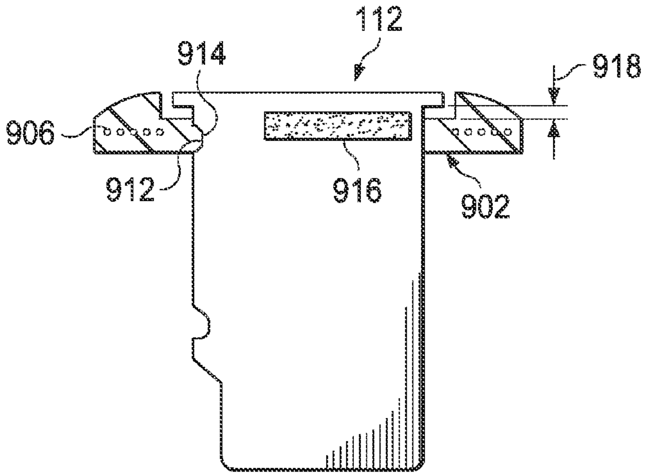

FIG. 9D

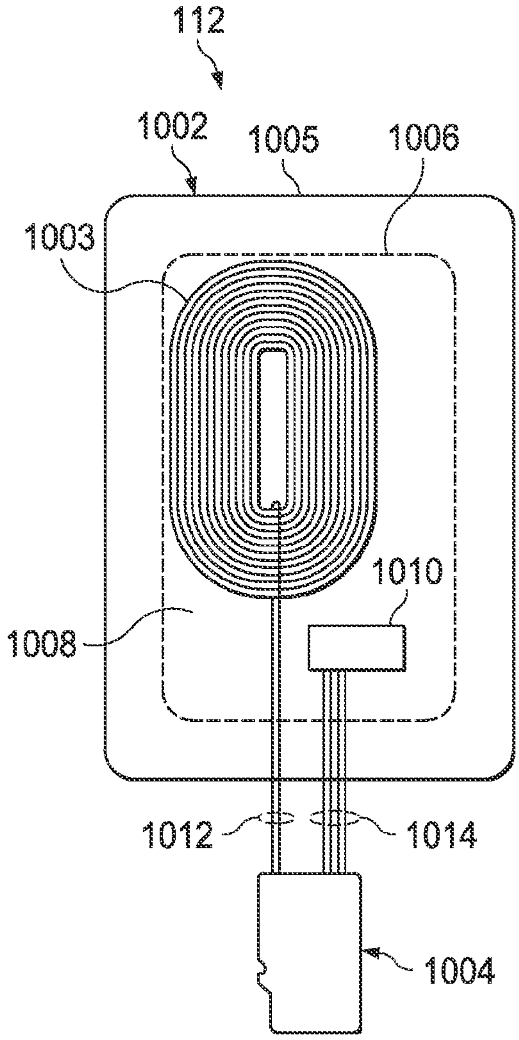

FIG. 10A

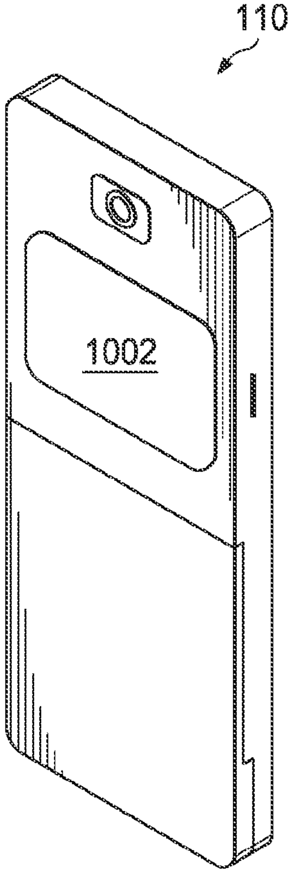

FIG. 10B

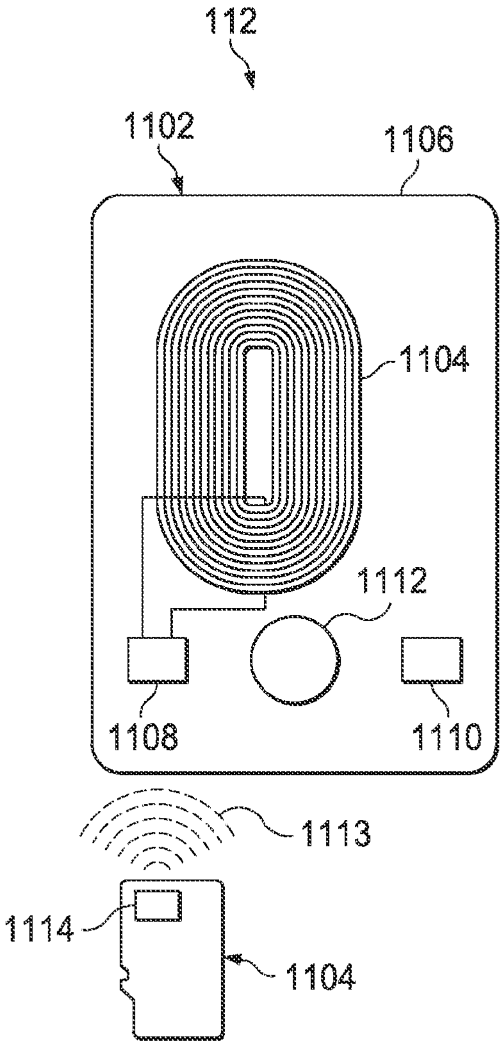

FIG. 11A

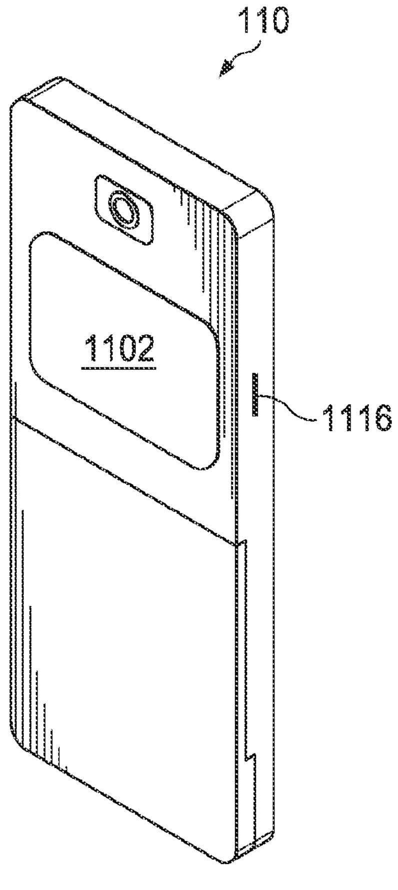

FIG. 11B

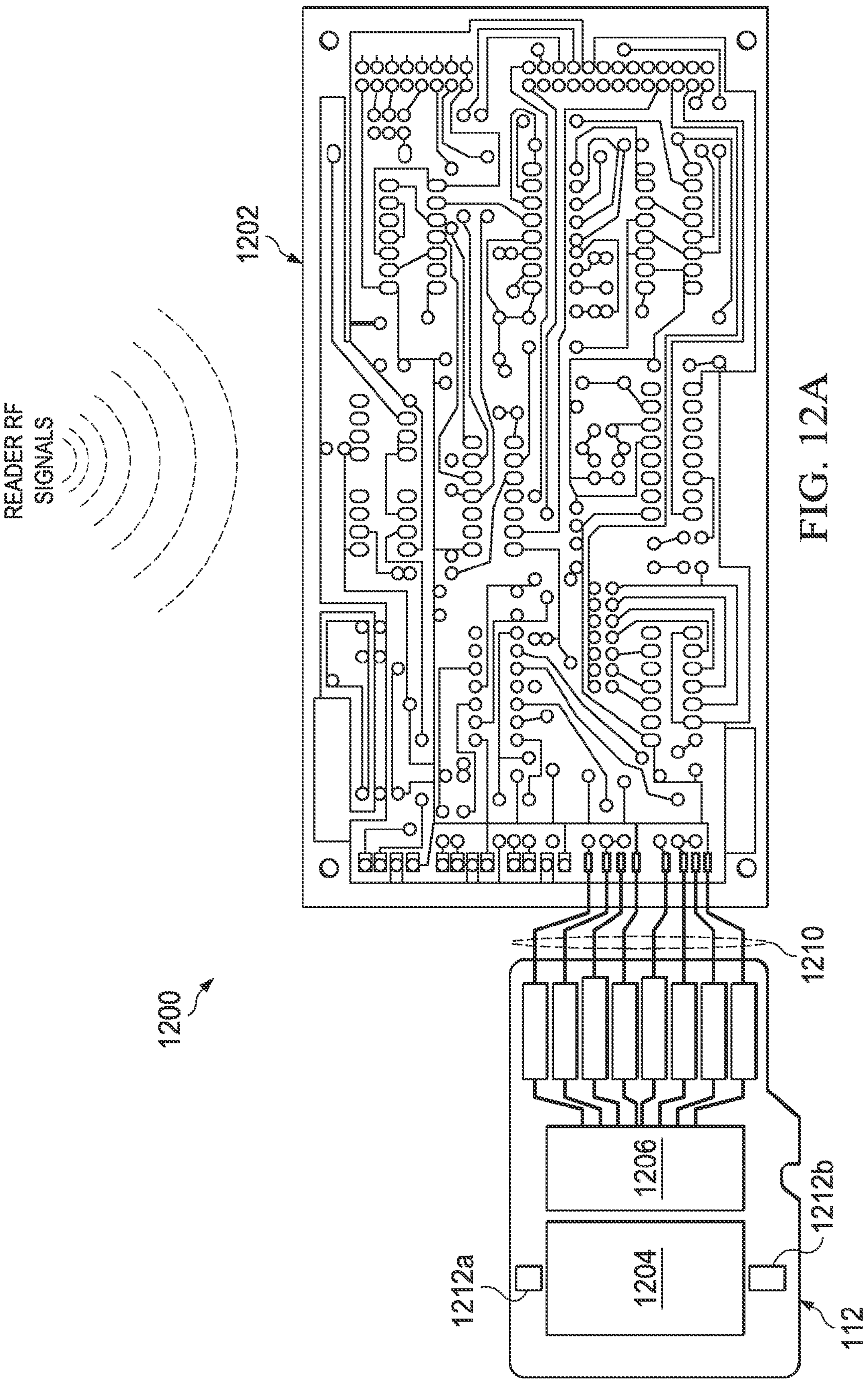

FIG. 12A

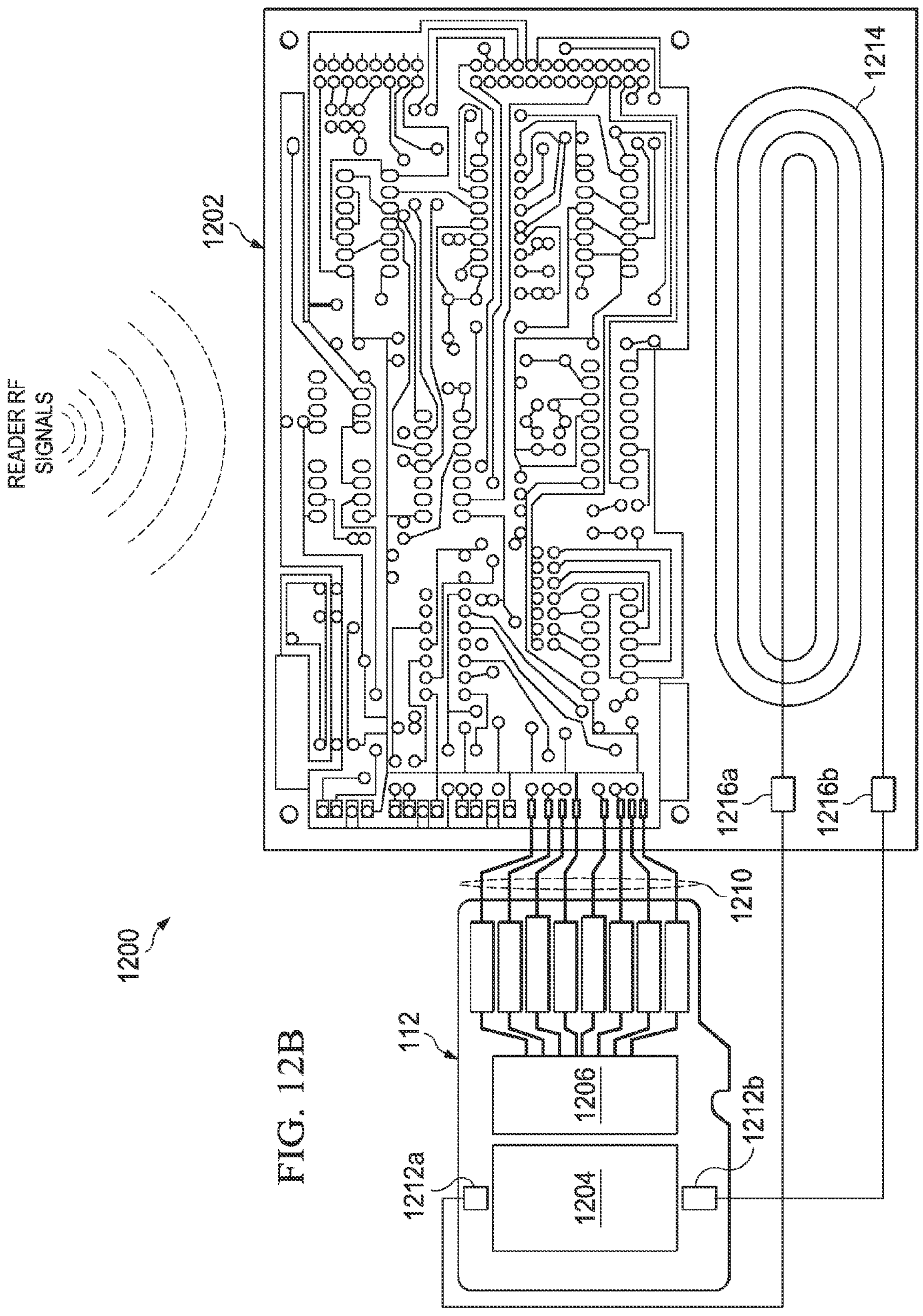
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FIG. 12B

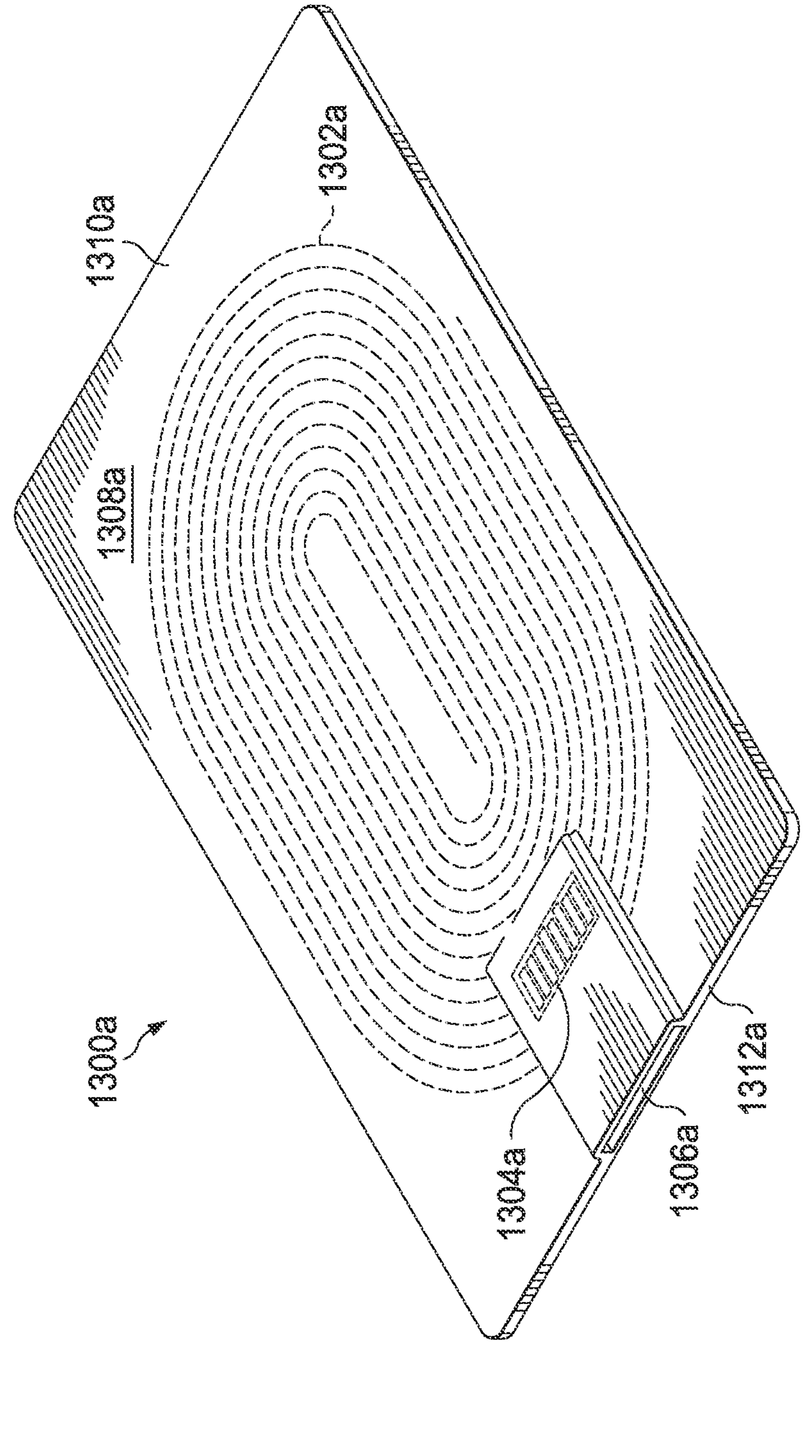


FIG. 13A

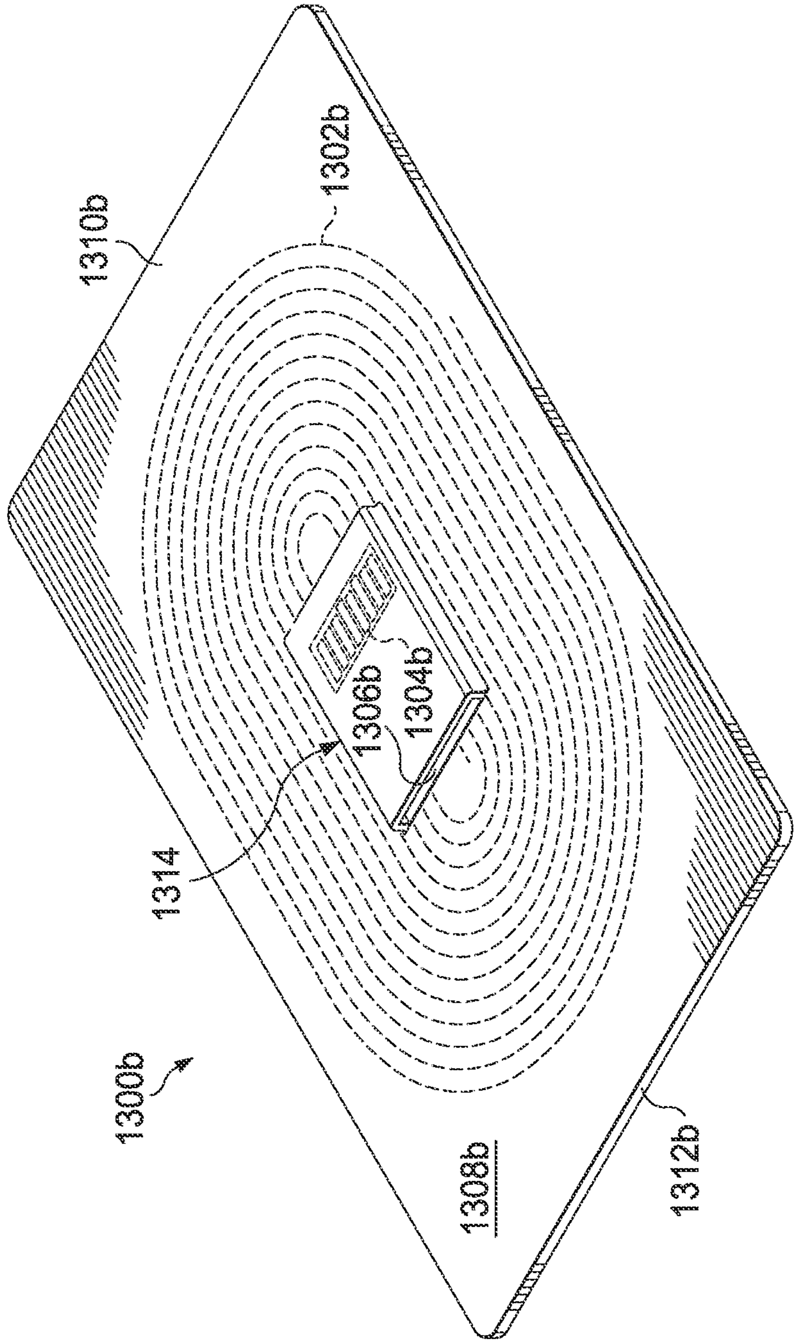


FIG. 13B

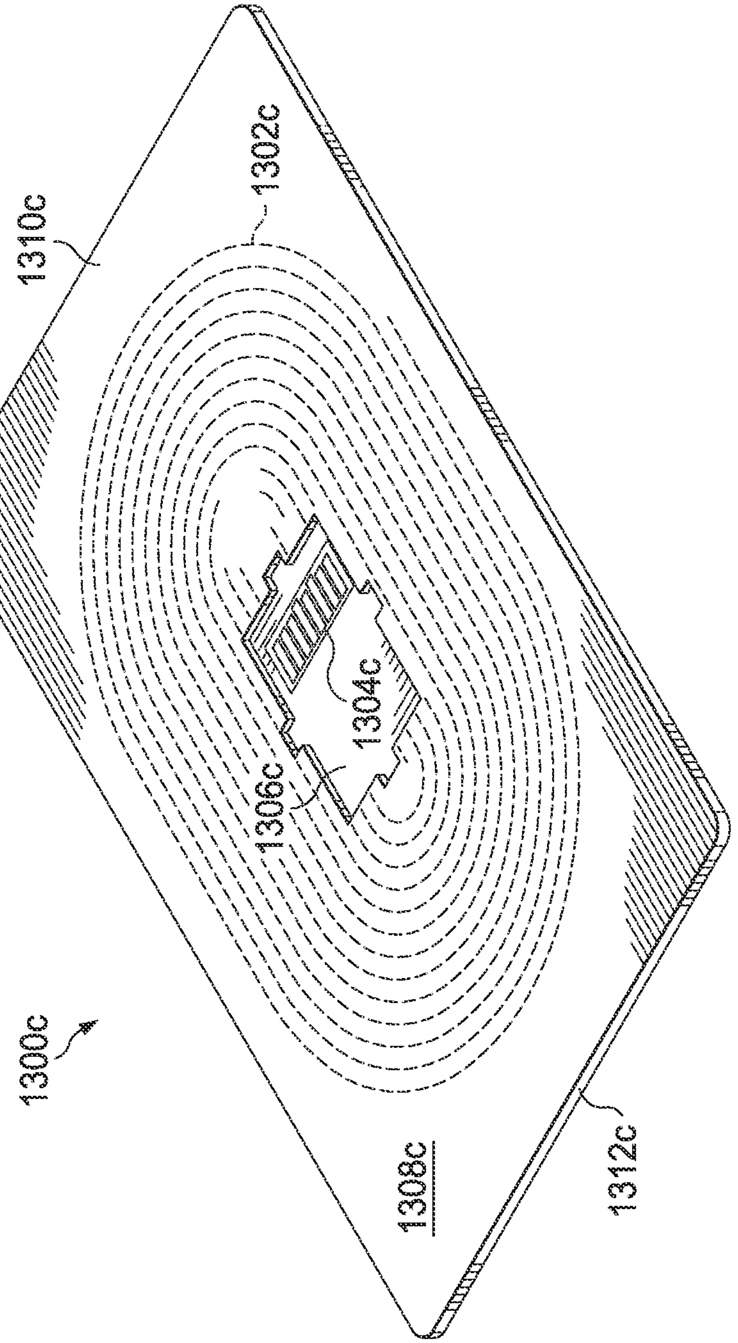


FIG. 13C

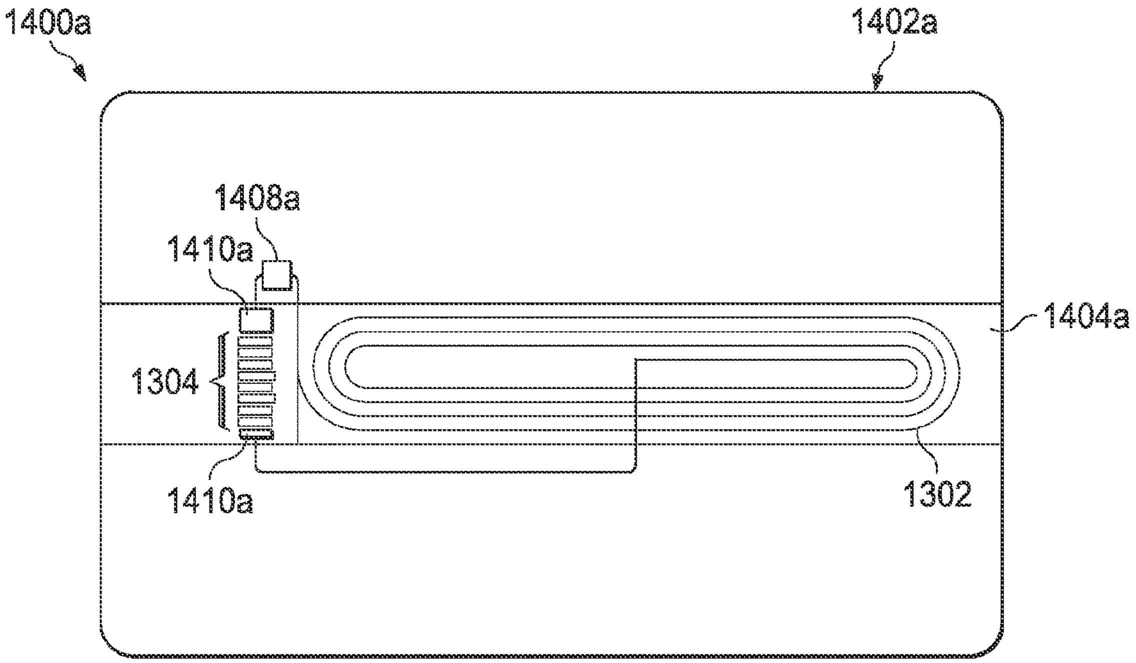


FIG. 14A

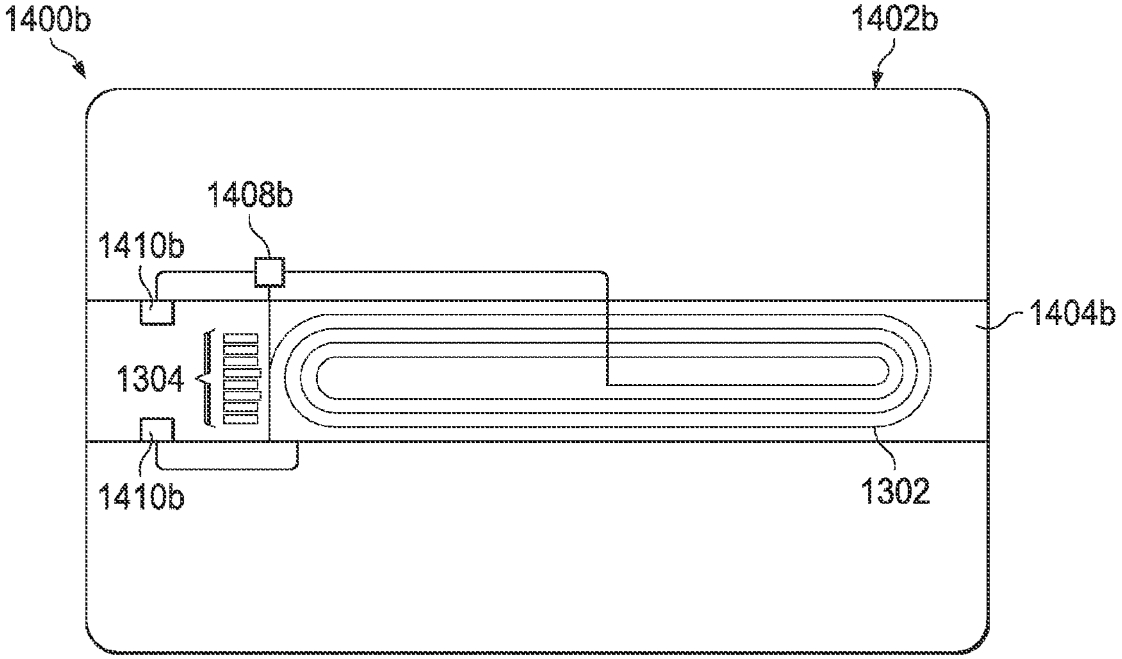


FIG. 14B

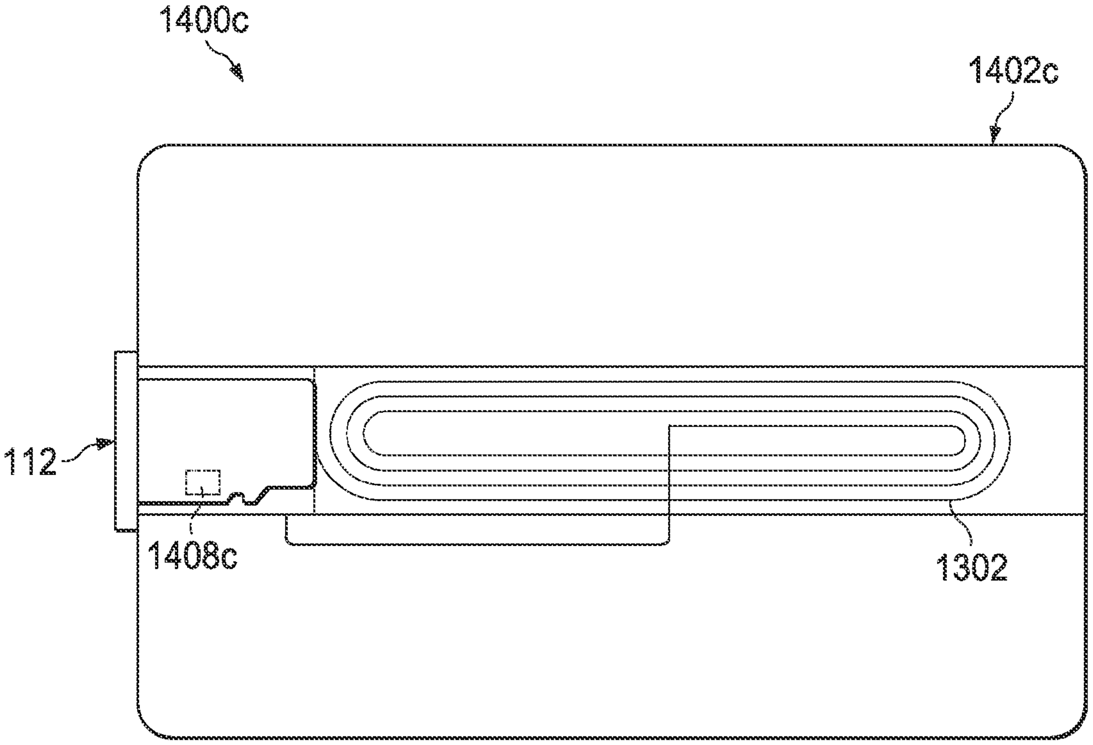
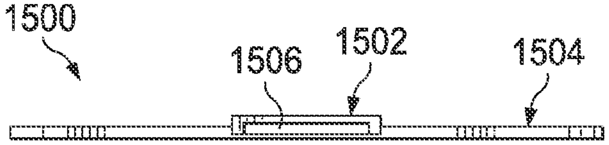


FIG. 14C



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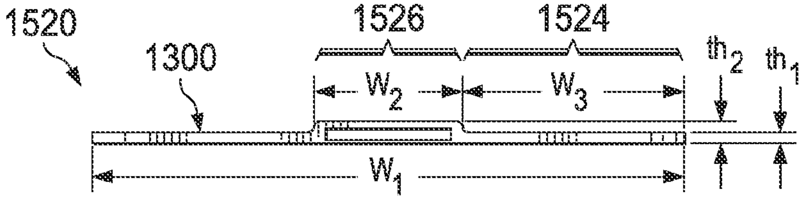

FIG. 15B

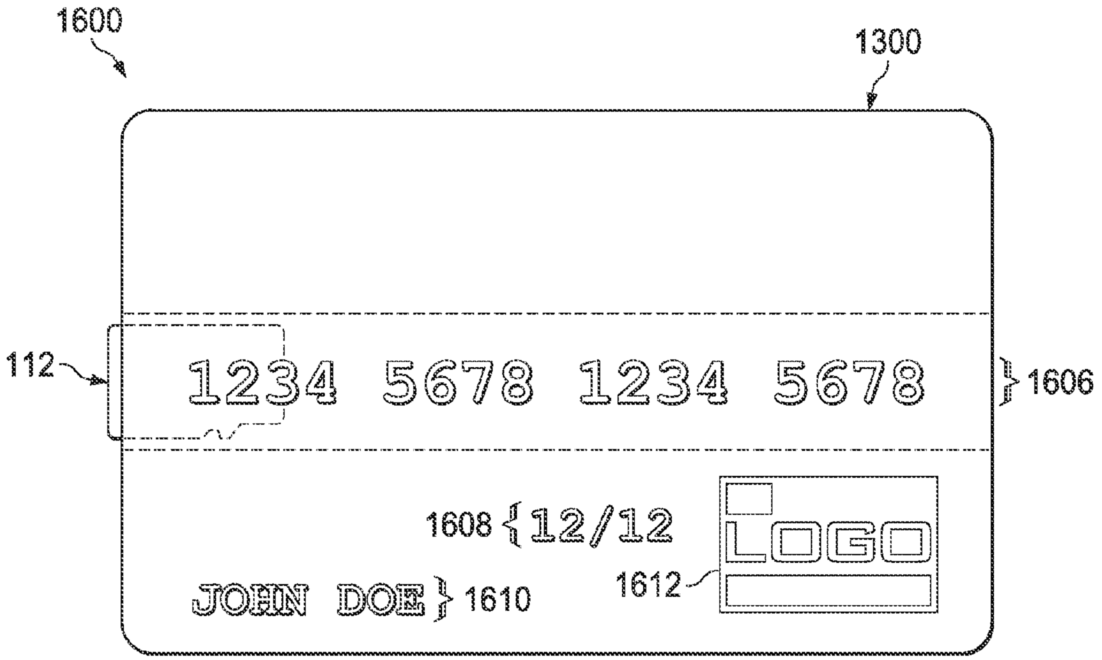

FIG. 16A

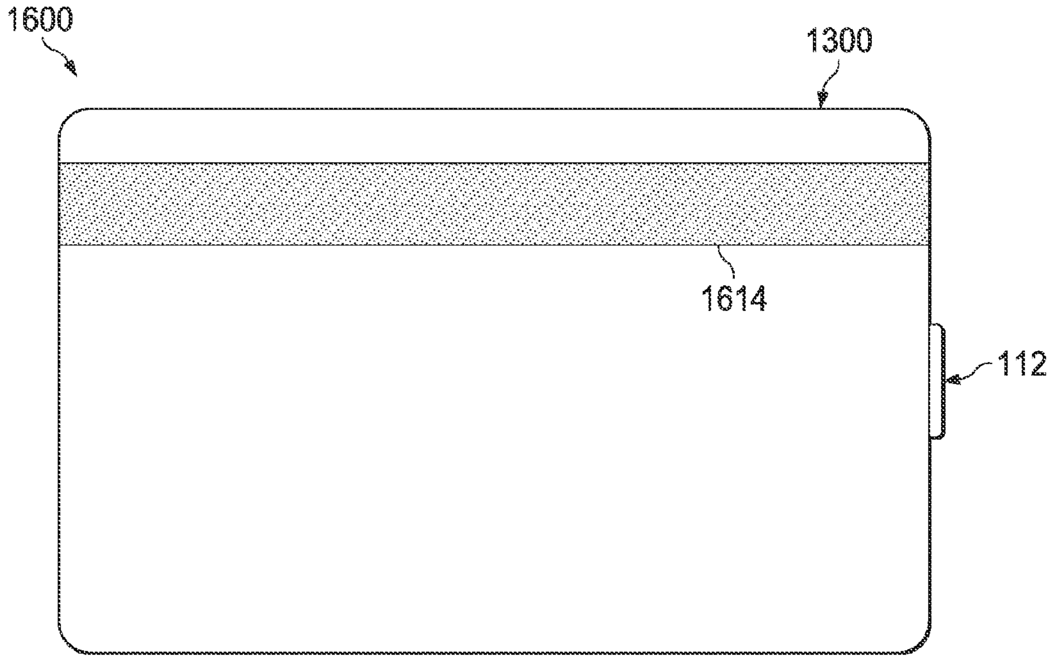

FIG. 16B

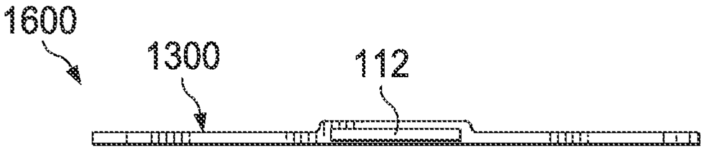

FIG. 16C

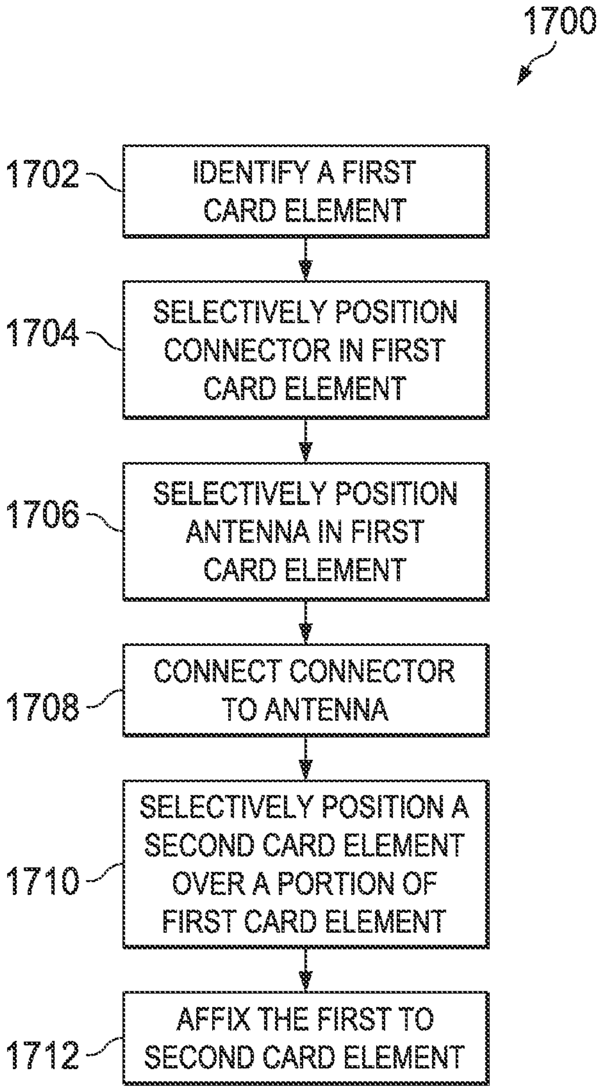
1700
1702
IDENTIFY A FIRST CARD ELEMENT
1704
SELECTIVELY POSITION CONNECTOR IN FIRST CARD ELEMENT
1706
SELECTIVELY POSITION ANTENNA IN FIRST CARD ELEMENT
1708
CONNECT CONNECTOR TO ANTENNA
1710
SELECTIVELY POSITION A SECOND CARD ELEMENT OVER A PORTION OF FIRST CARD ELEMENT
1712
AFFIX THE FIRST TO SECOND CARD ELEMENT

FIG. 17

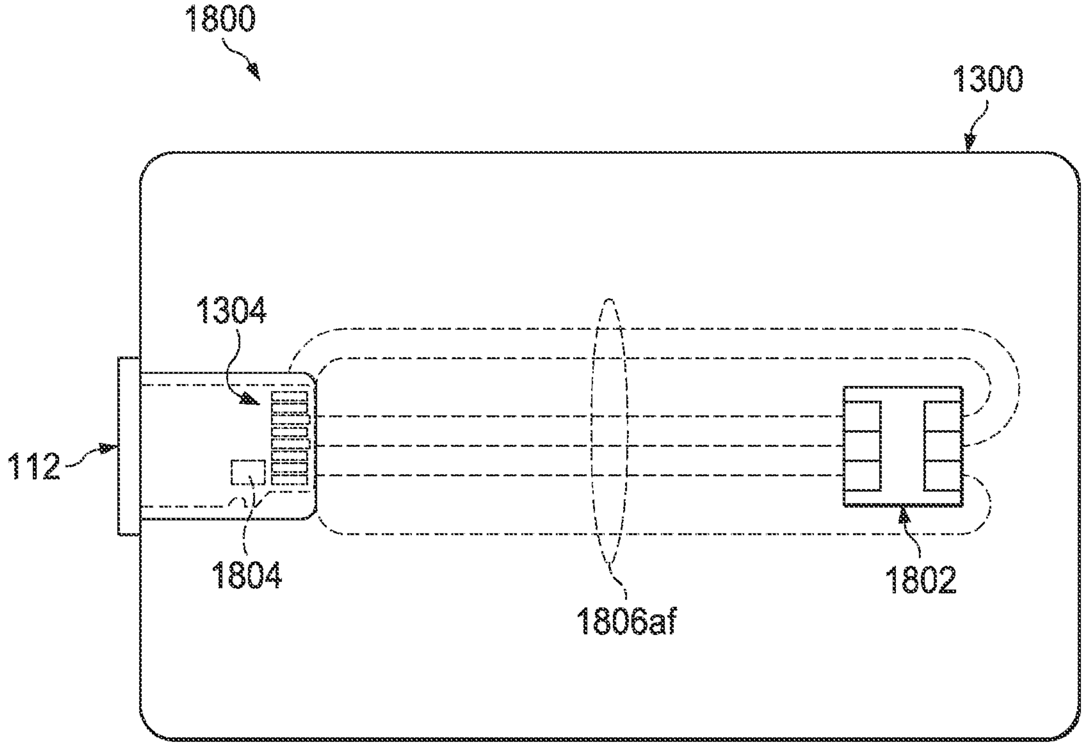

FIG. 18A

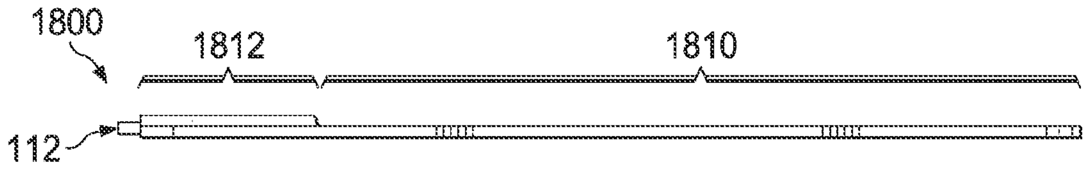

FIG. 18B

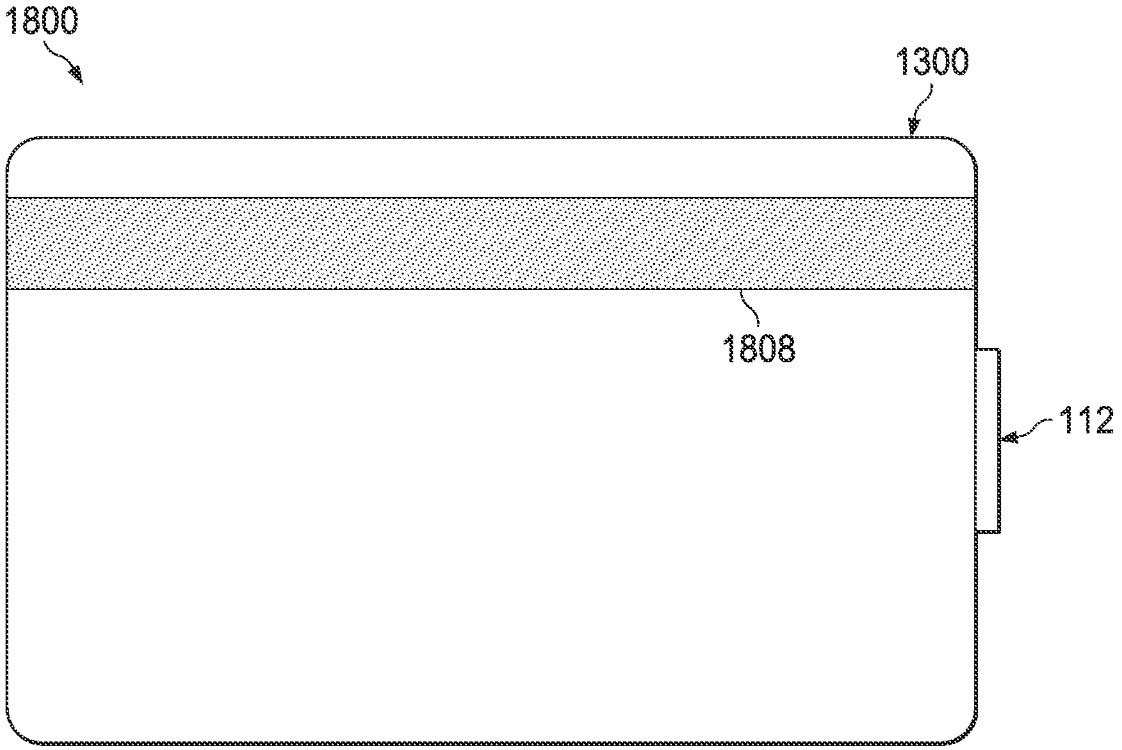

FIG. 18C

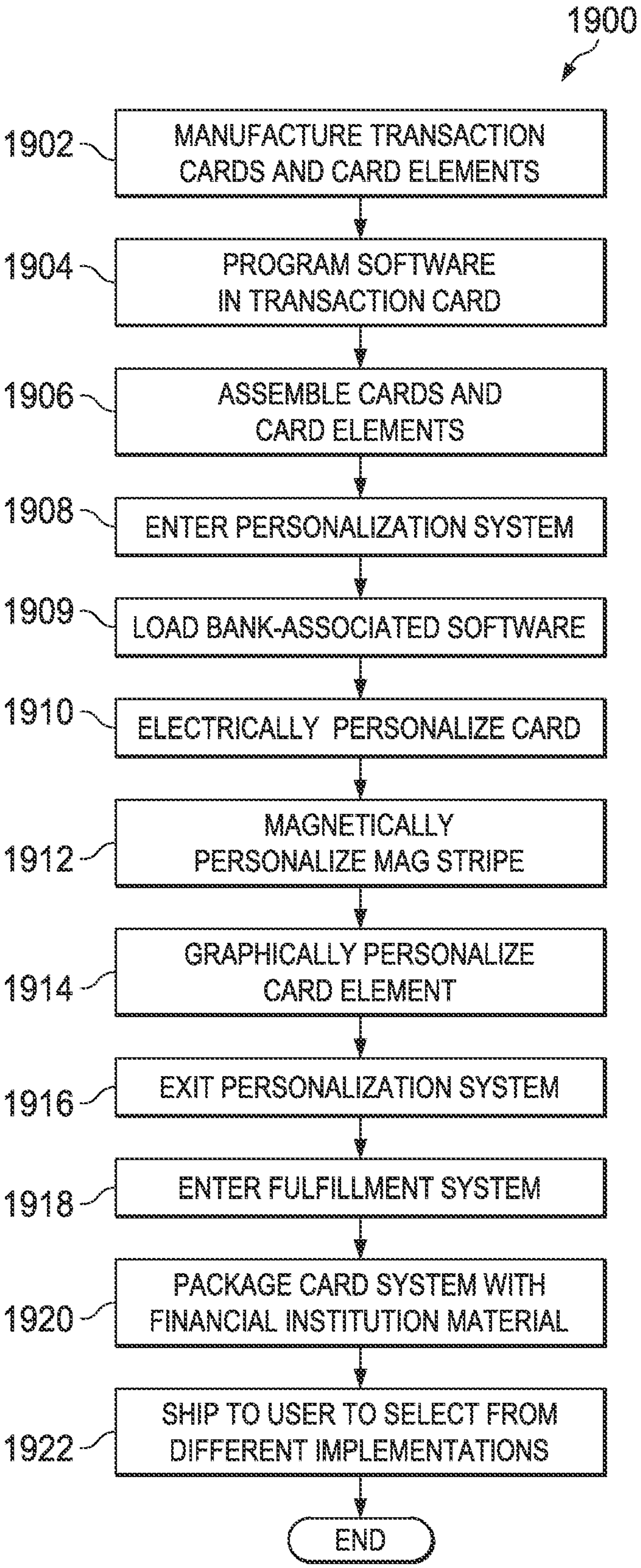
1900
1902
MANUFACTURE TRANSACTION CARDS AND CARD ELEMENTS
1904
PROGRAM SOFTWARE IN TRANSACTION CARD
1906
ASSEMBLE CARDS AND CARD ELEMENTS
1908
ENTER PERSONALIZATION SYSTEM
1909
LOAD BANK-ASSOCIATED SOFTWARE
1910
ELECTRICALLY PERSONALIZE CARD
1912
MAGNETICALLY PERSONALIZE MAG STRIPE
1914
GRAPHICALLY PERSONALIZE CARD ELEMENT
1916
EXIT PERSONALIZATION SYSTEM
1918
ENTER FULFILLMENT SYSTEM
1920
PACKAGE CARD SYSTEM WITH FINANCIAL INSTITUTION MATERIAL
1922
SHIP TO USER TO SELECT FROM DIFFERENT IMPLEMENTATIONS
END

FIG. 19

SWITCHING BETWEEN INTERNAL AND EXTERNAL ANTENNAS

CLAIM OF PRIORITY

This application is a continuation of and claims priority to U.S. patent application Ser. No. 12/568,592, filed Sep. 28, 2009, which is a continuation-in-part of and claims priority to U.S. patent application Ser. No. 12/272,527, filed Nov. 17, 2008, which is a continuation-in-part of and claims priority to U.S. patent application Ser. No. 12/209,087, filed Sep. 11, 2008, which claims priority under 35 U.S.C. §119(e) to U.S. Provisional Application No. 60/971,813, filed on Sep. 12, 2007, the entire contents of each of the above-identified cases are hereby incorporated by reference.

TECHNICAL FIELD

This invention relates to network communications and, more particularly, to switching between internal and external antennas.

BACKGROUND

Portable electronic devices and tokens have become an integrated part of the regular day to day user experience. There is a wide variety of common portable and handheld devices that users have in their possession including communication, business and entertaining devices such as cell phones, music players, digital cameras, smart cards, memory token and variety of possible combinations of the aforementioned devices and tokens. All of these devices share the commonality that consumer are accustomed to carrying them with them most of the time and to most places. This is true across the various demographics and age groups regardless of the level of the sophistication of the consumer, their age group, their technical level or background.

These common handheld devices offer options for expandable memory. Micro Secure Digital (microSD) is the popular interface across high-end cellphones while SD and MultiMediaCard (MMC) interfaces are also available in limited models. MicroSD is the least common denominator supported by the majority of these devices and tokens (in terms of size). In addition, adaptors are available to convert a MicroSD into MiniSD, SD, MMC and USB Although most popular MP3 player (iPOD) offer's a proprietary interface, competing designs do offer standard interfaces. Digital cameras offer mostly SD and MMC while extreme Digital (xD) is another option. Micro and Mini versions of these interfaces are also available in several models. Mini-USB is increasingly available across cellphones, digital cameras and MP3 players for synchronization with laptops.

SUMMARY

The present disclosure is directed to a system and method for switching between internal and external antennas. n some implementations, a system includes an antenna, a connector, and a housing. The antenna is configured to communicate wirelessly transactions with transaction terminals. The connector is connected to the antenna and configured to connect a transaction card to the antenna in response to at least insertion in the housing. The housing enclosing at least a portion of the antenna and at least a portion of the connector and including one or more elements that form an opening for receiving the transaction card. In addition, the housing is substantially rectangular and includes a first portion with a first thickness and a second portion with a second thickness different from the first thickness and at least the thickness of the transaction card. In some instances, the housing may provide additional communication methods such as a smart card contact and/or magnetic stripe to make contact transactions with transaction terminals.

The details of one or more embodiments of the invention are set forth in the accompanying drawings and the description below. Other features, objects, and advantages of the invention will be apparent from the description and drawings, and from the claims.

DESCRIPTION OF DRAWINGS

FIG. **1** is an example transaction system in accordance with some implementations of the present disclosure;

FIG. **2** is an example transactions system that transmits transaction information through a cellular core network;

FIG. **3** is an example intelligent card of FIG. **1** in accordance with some implementations of the present disclosure;

FIG. **4** is an example intelligent card that selectively switching an antenna;

FIGS. **5**A and **5**B illustrate an example of antenna design **1**;

FIGS. **6**A and **6**B illustrate another example of antenna design

FIGS. **7**A and **7**B illustrate another example of antenna design

FIGS. **8**A-**8**C illustrate another example of antenna design;

FIGS. **9**A-**9**D illustrate another example of antenna design;

FIGS. **10**A and **10**B illustrate another example of antenna design;

FIGS. **11**A and **11**B illustrate another example of antenna design; and

FIG. **12** illustrates yet another example of an antenna design;

FIGS. **13**A-C illustrate example card elements for receiving transaction cards of FIG. **1**;

FIGS. **14**A-C illustrate example bottom portions of the card elements in FIGS. **13**A-C;

FIGS. **15**A and **15**B illustrate example side views of card elements;

FIGS. **16**A-C illustrate an example card element of FIG. **13**A;

FIG. **17** is a flow chart illustrating an example method for manufacturing card elements;

FIGS. **18**A-C illustrate an example card system including a smart-card interface; and

FIG. **19** is a flow chart illustrating an example method for personalizing a card system.

Like reference symbols in the various drawings indicate like elements.

DETAILED DESCRIPTION

FIG. **1** is a block diagram illustrating an example transaction system **100** for wirelessly executing transactions using an intelligent card independent of a host device. For example, the system **100** may include a micoSecure Digital (microSD) card that executes transactions with financial institutions independent of a host device. Aside from microSD, the system **100** may include other mass storage interfaces that connect an intelligent card to the host device such as, for example, MultiMediaCard (MMC), SD, Universal Serial Bus (USB), Apple iDock, Firewire, and/or others. An intelligent card is a device configured to insert into or otherwise attach to a host device and access or otherwise execute services (e.g., transactions) independent of the host device. In some implementations, the intelligent card may be shaped as a microSD card including, for example, notches, raised portions and/or other features. The system **100** may include an intelligent card that includes a dual interface. The dual interface may connect the intelligent card to both the host device through a physical interface (e.g., SD, MMC, USB) and external devices through a wireless connection (e.g., NFC, ISO 14443). In some implementations, the intelligent card may include an embedded secure chip, Central Processing Unit (CPU) with operating system, local memory and value added applications accessible by the user through the host device. A host device may include a cellphone, a smartphone, a Personal Digital Assistant (PDA), a MPEG-1 Audio Layer 3 (MP3) device, a digital camera, a camcorder, a client, a computer, and/or other device that includes a mass memory and/or peripheral interface. In some implementations, the intelligent card can operate as a master with the host device being a slave such that the intelligent card controls operational aspects of the host device such as a user interface. The intelligent card in the system **100** may execute one or more of the following: selectively activate an antenna for wireless transactions in response to at least an event; verify the host device with a financial institution through, for example, a Point Of Sale (POS) using a host signature; execute a transaction with a financial institution through, for example, a POS terminal independent of the host device; and/or other processes. By providing an intelligent card, the system **100** may wirelessly execute transactions with financial institutions without either requiring additional hardware, software, and/or firmware on the host device and/or without requiring changes to existing hardware, software, and/or firmware for reader terminals to enable a user to wirelessly execute a transaction.

At a high level, the system **100** includes an offline store **102** and clients **104***a* and **104***b* coupled to financial institutions **106** through a network **108**. While not illustrated, the system **100** may included several intermediary parties between the financial institution **106** and the network such as, for example, a transaction acquirer and/or a payment network host. The offline store **102** includes a mobile device **110***a* having a transaction card **112***a* and a Point of Sale (POS) device **114** that executes transactions with customers. The POS device **114** includes a Graphical User Interface (GUI) **109** for presenting information to and/or receiving information from users. In some implementations, the POS **114** may transmit a request to execute a transaction to the transaction card **112**. The transaction card **112** may transmit authentication information to the POS **114**. The client **104** includes the GUI **115** for presenting information associated with the system **100**. The client **104***a* includes a card reader **116** that interfaces the transaction card **112***c* with the client **104***a*. The financial institution **106** may authorize the transaction based, at least in part, on information transmitted by the transaction card **112**. The mobile device **110** includes a GUI **111** for presenting information associated with financial transactions.

The offline store **102** is generally at least a portion of an enterprise having a physical presence (e.g., building) for operations. For example, the offline store **102** may sell goods and/or services at a physical location (e.g., a brick-and-mortar store) directly to customers. In this example, the offline store **102** buys or otherwise receives goods (e.g., produce) from distributors (not illustrated) and then may sell these goods to customers, such as users of the mobile device **110**. In general, the offline store **102** may offer face-to-face experiences with customers in providing goods and/or services. For example, the offline store **102** may be a click-and-mortar store such that a user selects a good or service using the Internet and purchases and receives the good or service at the offline store **102**. The offline store **102** may provide one or more of the following services associated with goods: inventory, warehousing, distribution, and/or transportation. As a result, the offline store **102** may not immediately distribute goods received from distributors. The offline store **102** may include a single retail facility, one or more retail facilities at a single geographic location, and/or a plurality of retail facilities geographically distributed. In some cases, two or more entities may represent portions of the same legal entity or affiliates. For example, the offline store **102** and distributors may be departments within one enterprise. In summary, the offline store **102** may wirelessly execute financial transactions with the mobile device **110**.

Each mobile device **110** comprises an electronic device operable to interface with the transaction card **112***a*. For example, the mobile device **110** may receive and transmit wireless and/or contactless communication with the system **100**. As used in this disclosure, the mobile devices **110** are intended to encompass cellular phones, data phones, pagers, portable computers, SIP phones, smart phones, personal data assistants (PDAs), digital cameras, MP3 players, camcorders, one or more processors within these or other devices, or any other suitable processing devices capable of communicating information with the transaction card **112**. In some implementations, the mobile devices **110** may be based on a cellular radio technology. For example, the mobile device **110** may be a PDA operable to wirelessly connect with an external or unsecured network. In another example, the mobile device **110** may comprise a smartphone that includes an input device, such as a keypad, touch screen, mouse, or other device that can accept information, and an output device that conveys information associated with a transaction with the offline store **102**, including digital data, visual information, or GUI **111**.

The GUI **111** comprises a graphical user interface operable to allow the user of the mobile device **110** to interface with at least a portion of the system **100** for any suitable purpose, such as authorizing transactions and/or displaying transaction history. Generally, the GUI **111** provides the particular user with an efficient and user-friendly presentation of data provided by or communicated within the system **100** and/or also an efficient and user-friendly means for the user to self-manage settings and access services offered by the financial institution **106**. The GUI **111** may comprise a plurality of customizable frames or views having interactive fields, pull-down lists, and/or buttons operated by the user. The term graphical user interface may be used in the singular or in the plural to describe one or more graphical user interfaces and each of the displays of a particular graphical user interface. The GUI **111** can include any graphical user interface, such as a generic web browser or touch screen, that processes information in the system **100** and presents the results to the user.

The transaction card **112** can include any software, hardware, and/or firmware configured to wirelessly execute transactions with the POS device **114**. For example, the transaction card **112** may execute a contactless transaction with the POS device **114** independent of the mobile device **110***a*. In other words, the transaction card **112** may wirelessly execute transactions without aspects of the transaction being executed by the mobile device **110**. The transaction card **112** may execute transactions with the POS device **114** using short range signals such as NFC (e.g., ISO 18092/ECMA 340), ISO 14443 type A/B, ISO 15693, Felica, MiFARE, Bluetooth, Ultra-wideband (UWB), Radio Frequency Identifier (RFID), contactless signals, proximity signals, and/or other signals compatible with retail payment terminals (e.g., POS **114**). In some implementations, the transaction card **112** may include one or more chipsets that execute an operating system and security processes to independently execute the transaction. In doing so, the mobile device **110** does not require additional hardware, software, and/or firmware to wirelessly execution a transaction with the POS **114** such as an NFC transaction. In some implementations, the transaction card **112** may execute one or more of the following: wirelessly receive a request from the POS device **114** to execute a transaction and/or and provide a response; translate between wireless protocols and protocols compatible with the transaction card **112**; translate between transaction-card protocols and protocols compatible with mobile device **110**; present and receive information (e.g., PIN request, PIN) from the user through the GUI **111**; decrypt and encrypt information wirelessly transmitted between the transaction card **112** and the POS **114**; execute applications locally stored in the transaction card **112**; selectively switch the antenna of the transaction card **112** on and off based, at least in part, on one or more events; execute authentication processes based, at least in part, on information received, for example, through the GUI **111**; transmit a host signature to POS **114** in response to at least a transaction challenge; store, at least in part, details of the transaction executed between place between the card **112** and the POS device **114**; generate and/or present alerts (e.g., audio-visual alerts) to the user through the GUI **111**; generate and/or transmit wireless-message alerts to the financial institution **106** using the mobile device **110** if cellular capable; and/or others. In some implementations, the transaction card **112** may include a communication module with of a protocol translation module, antenna tuning circuit, power circuit and a miniature antenna tuned to exchange wireless data with a retail terminal **114**.

In some implementations, the transaction card **112** may initiate a transaction in response to at least a user selecting a graphical element in the GUI **111**. The transaction card **112** may initiate a transaction with the POS **114** in response to at least wireless request transmitted by the POS **114**. In some implementations, the transaction card **112** may selectively switch the antenna between an on and off state in response to one or more events. The one or more events may include a user request, completion of transaction, insertion of card **112** in a different mobile device, location change, timer events, detection of incorrect PIN entered by the user, change of wireless network that the device is connected to, message received from the financial institution **106** using wireless communication methods such as SMS, and/or other events. For example, the transaction card **112** may receive one or more commands to switch the antenna off from a cellular network (not illustrated) through the mobile device **110**. In some implementations, the transaction card **112** may request user identification such as a PIN, a user ID and password combination, biometric signature, and/or others.

In regards to translating between protocols, the transaction card **112** may process information in, for example, ISO 7816, a standard security protocol, and/or others. In this case, the transaction card **112** may translate between an NFC protocol (e.g., ISO 18092) and the transaction-card protocol. In some implementations, ISO 7816 commands may be encapsulated within interface commands used to transmit data between the host device **114** and the card **112**. In addition, the transaction card **112** may interface the mobile device **110** through a physical interface such as MicroSD, Mini-SD SD, MMC, miniMMC, microMMC, USB, miniUSB, microUSB, firewire, Apple iDock, and/or others. In regard to security processes, the transaction card **112** may implement one or more encryption algorithms to secure transaction information such as card number (e.g., credit card number, debit-card number, bank account number), PIN, and/or other security related information. The security related information may include an expiry date, card verification code, user name, home phone number, user zip code and/or other user information associated with verifying an identity of the card holder. In some implementations, the transaction card **112** may execute private key (symmetric algorithms) such as DES, TDES and/or others or public key (asymmetric algorithms) such as RSA, elliptic curves, and/or others. In addition, the transaction card **112** may include memory (e.g., Flash, EEPROM) for storing user data, applications, offline Webpages, and/or other information. In regards to applications, the transaction card **112** may execute a locally stored application and present information to and received information from the user through the GUI **111**. For example, the transaction card **112** may execute an application used to synchronize an account balance with the financial institution **106** using the GUI **111** and the mobile device **110**. Alternatively or in addition to applications, the transaction card **112** may present offline Web pages to the user using the GUI **111**. In response to initiating a transaction, the transaction card **112** may automatically present an offline Web page through the GUI **111**. In some implementations, the offline Web page can be associated with a financial institution **106**. In some implementations, the transaction card **112** can be backward compatible and operate as a mass storage device. For example, if the wireless interface of the transaction card **112** is not available or deactivated, the transaction card **112** may operate as a mass storage device enabling users to access data stored in the memory component (e.g., Flash). In some implementations, the transaction card **112** can execute a set of initialization commands in response to at least insertion into the mobile device **110**. These initialization commands may include determining device related information for the mobile device **100** (e.g., phone number, signature, connected network information, location information and other available properties), determining user relating information (e.g., PIN code, activation code), incrementing counters, setting flags and activating/deactivating functions according to pre-existing rules and/or algorithms.

In some implementations, the transaction card **112** may automatically execute one or more fraud control processes. For example, the transaction card **112** may identify an operational change and automatically transmit a notification to the financial institution based, at least in part, on the identified change. The transaction card **112** may execute two fraud control processes: (1) determine a violation of one or more rules; and (2) automatically execute one or more actions in response to at least the violation. In regards to rules, the transaction card **112** may locally store rules associated with updates to operational aspects of the transaction card **112**. For example, the transaction card **112** may store a rule indicating a change in mobile host device **110** is an operational violation. In some implementations, the transaction card **112** may store rules based, at least in part, on updates to one or more of the following: phone number of host device **110**; MAC address of host device **110**; network wirelessly connected to host device **110**; location of host device; and/or other aspects. In response to one or more events matching or otherwise violating rules, the transaction card **112** may execute one or more processes to substantially prevent or otherwise notify the financial institutions **106** of potentially fraudulent activity. For example, the transaction card **112** may execute a command to block an associated user account and/or the transaction card **112**. Alternatively or in addition, the transaction card **112** may transmit a command to the financial institution **106** to call the mobile host device **110**. In some implementations, the transaction card **112** may execute a command based, at least in part, on an event type. In some examples, the transaction card **112** may initiate a call with the financial institution **106** in response to at least a change in number of the host device **110**. In some examples, the transaction card **112** may re-execute an activation process in response to at least a specified event type. An activation process may include activating the transaction card and/or financial account as discussed in more detail with respect to FIG. **9**. In some implementations, the transaction card **112** may execute a command to disconnect the GUI **111** from the transaction card **112**. The transaction card **112** may present a disconnection notification through the GUI **111** prior to executing the command. In some implementations, the transaction card **112** may transmit a command to the financial institution **106** to deactivate an account associated with the card **112**.

In some implementations, the POS **114** may transmit a transaction request **117** to the transaction card **112** for information to generate an authorization request **118**. In response to at least the transaction request, the transaction card **112** may transmit one or more transaction responses **119** identifying information associated with a payment account. In some implementations, the POS device **114** may transmit a request **118** to authorize a transaction to the financial institution **106**. The authorization information may include an account number, a transaction amount, user credentials, and/or other information. In response to at least the transaction request **118**, the financial institution **106** may transmit an authorization response **120** to the POS device **114**. In some implementations, the POS device **114** may transmit the response **120** to the transaction card **112**. The transaction response **120** may include, for example, a receipt presentable to the user through the GUI **111***a*. In some implementations, the financial institution **106** may transmit the authorization response **120** to the mobile device through a cellular core network (see FIG. **2**). In this implementation, the financial institution **106** may have stored the association between the mobile device **110** and the transaction card **112** during the user sign-up process, automatically upon user activation of the card **112** when, for example, the card **112** is initially inserted into the mobile device **110**, and/or other event. In the illustrated implementation, the POS **114** includes the GUI **109**.

The GUI **109** comprises a graphical user interface operable to allow the user of the POS **114** to interface with at least a portion of the system **100** for any suitable purpose, such as a user entering transaction information (e.g., PIN, transaction acceptance) and/or and presenting transaction information (e.g., transaction amount). Generally, the GUI **109** provides the particular user with an efficient and user-friendly presentation of data provided by or communicated within the system **100** and/or also an efficient and user-friendly means for the user to initiate a wirelessly transaction with the transaction card **112**. The GUI **109** may present a series of screens or displays to the user to, for example, accept a transaction and enter security information such as a PIN.

In some implementations, the transaction card **112** can be implemented differently. The transaction card **112** may be implemented as a KeyFOB and remains live outside the mobile device **110** as a FOB. In this case, the transaction card **112** may be passive and powered from an induction magnetic field generated by the POS **114**. The transaction card **112** may be implemented in the form of an industrial integrated circuit chip for mounting on a PCB or IC chip. In some implementations, the transaction card **112** may be implemented in the form of a self contained desktop standalone unit powered by external AC adapter or stand alone box. In some implementations, the transaction card **112** can be implemented as an external attachment to a mobile device **110** (e.g., case) and connected to the mobile device using a peripheral interface such as USB, serial port, the iDock apple proprietary interface, and/or other interface.

In some implementations, the transaction card **112** may operate in accordance with one or more of the following modes: active card emulation; active reader; self train; killed; memory; inactive; and/or other modes. The transaction card **112** may operate active-card-emulation mode to convert the mobile device **110** to a contactless payment device loaded with a financial vehicle (FV) that may be, for example, a credit card, a debit card, a gift card and/or other retail payment product. In this mode, the transaction card **112** may execute payment transactions at any capable retail payment terminal (e.g., POS **114**) that accepts contactless payment transactions. For example, such terminals may be contactless-enabled terminals currently being deployed by merchants under MasterCard's paypass, Visa's paywave programs, Amex ExpressPay, Discover Zip, and/or other payment programs. After the antenna of the transaction card **112** is activated in this mode, a merchant terminal may detect the presence of a host device with the transaction card **112** and prompt the user to authorize a transaction such as by entering a PIN, signing on a terminal interface, confirming the amount of the transaction, and/or other action. In this mode, such transactions may be handled as a normal card-present transaction. In other words, the POS **114** may perceive the transaction card **112** as a contactless plastic payment card and may communicate with the transaction card **112** as a contactless plastic payment card to execute payment transactions. In these implementations when the card **112** operates in an active-card emulation mode, the POS **114** can wirelessly communicate with the transaction card **112** using the same signals used to communicate with a contactless plastic payment card. In this active-card emulation mode, the transaction card **112** emulates a contactless plastic payment card and may be backward compatible with the POS **114**. In this implementation, neither the terminal nor the financial institution may require additional software to execute the transaction. In addition, the transaction card **112** in this mode may be used for other applications such as physical access control (to open gates either in a corporate environment or in a transit environment), logical access control (to request network access via a PC), application access control (to buy access for amenities such as transportation, movies or wherever payment needs to be made to gain access to a facility), and/or other applications.

In the active-reader mode, the transaction card **112** may convert the mobile device **110** to a contactless reader device capable of receiving data when in range of a transmitting terminal (e.g., POS **114**). In some implementations, this mode can require special NFC hardware with reader mode capability as part of the transaction card **112**. In the event that the mobile device **110** is proximate (e.g., 10 cm or less) a transmitting terminal, the reader mode of the transaction card **112** may activated and prompt the user for authorization to receive data through the GUI **111**. This mode may only be suitable for mobile devices **110** with a UI element, such as an OK button and a screen, an LED to indicate that data reception is being requested, and/or other interfaces. Once the user authorizes the transmission, the transaction card **112** in this mode may receive, and locally store, process and may execute a transaction and/or forward received data to another entity. For example, the transaction card **112** in this mode may receive content through promotional posters, validating the purchase of a ticket, and/or others. For example, the transaction card **112** in this mode may function as a mobile POS terminal receiving transaction information from a plastic contactless card/FOB and instructing the POS **114** to prepare a transaction authorization request for the financial institution **106** through a cellular core network. Once the financial institution **106** authorizes the transaction, the mobile device **110** may display the confirmation of the transaction to the user through the GUI **111**.

In regards to the self-train mode, the transaction card **112** may execute a version of the reader mode. In some implementations, the self-train mode can be activated by a special action (e.g., a needle point press to a small switch, entry of an administrative password via the GUI **111**). In response to at least activating this mode, the transaction card **112** may be configured to receive personalization data over, for example, the short range wireless interface from another peer transaction card such as the plastic contactless cards compliant with this functionality and issued by the financial institution **106** or a specially prepared administrative card for this purpose. Personalization data received in this mode may include encrypted FV information that is stored in secured memory of the transaction card **112**. In some implementations, the transaction card **112** in this mode may receive the FV information through a contactless interface of a transmitter and/or others. The transaction card **112** may then synthesize the FV information that corresponds to the user account and personalize an internal security module that includes, for example, payment applications for executing transactions with financial institutions **106** and associated user credentials. The self-train mode may be used to re-personalize the transaction card **112** in the field. In some implementations, all previous data can be deleted if the self-train mode is activated. The self-train mode may be a peer-to-peer personalization mode where the card **112** may receive personalization information from another transaction card **112**. This mode may represent an additional personalization mode as compared with factory, store and/or Over-The-Air (OTA) personalization scenarios which may be server to client personalization scenarios. In some implementations, the self-train mode may be a peer-to-peer personalization mode where the transaction card **112** receives personalization information from another transaction card. Since two transaction cards **112** are used in this mode, this mode may be different from a server-to-client personalization scenario as with a factory, store, and OTA personalization.

In regards to the inactive mode, the transaction card **112** may temporarily deactivate the contactless interface. In some implementations, the inactive mode can be activated through the physical interface with the mobile device **110** such as a microSD interface. In response to at least the activation of the inactive mode, the transaction card **112** may temporarily behave as only a mass-memory card. In some implementations, the card **112** may also enter this state when the reset needle point is pressed. In this mode, the transaction card **112** may preserve locally-stored information including financial user data. In this mode, the transaction card **112** may execute the activation process and if successful may return to the active mode. Financial institutions **106** may use this mode to temporarily prevent usage in response to at least identifying at least potentially fraudulent activity.

In regards to the killed mode, the transaction card **112** may permanently deactivate the contactless interface. In some implementations, the killed mode is activated through the physical interface with the mobile device **110** such as a microSD interface. In response to at least the activation of the killed mode, the transaction card **112** may permanently behaves as a mass memory stick. In the event that the reset needle point is pressed, the transaction card **112** may, in some implementations, not be made to enter any other modes. In addition, the transaction card **112** may delete financial content in memory in response to at least this mode being activated. In some implementations, financial institutions **106** may use this mode to delete data from a transaction card **112** that is physically lost but still connected to the wireless network via the host device **110**.

In regards to the memory mode, the transaction card **112** may operate as a mass memory stick such that the memory is accessible through conventional methods. In some implementations, the transaction card **112** may automatically activate this mode in response to at least being removed from the host device, inserted into a non-authorized host device, and/or other events. The transaction card **112** may be switched to active mode from the memory mode by, for example, inserting the card **112** into an authorized device or may be switched from this mode into the self-train mode to re-personalize the device for a new host device or a new user account. In some implementations, the memory mode may operate substantially same as the inactive mode.

In some implementations, the transaction card **112** may be re-personalized/updated such as using software device management process and/or a hardware reset. For example, the user may want to re-personalize the transaction card **112** to change host devices, to have multiple host devices, and/or other reasons. In regards to the software device management, the user may need to cradle the new host device with the transaction card **112** inserted to launch the software device management application. In some implementations, the software management application can be an application directly installed on the client **104**, integrated as a plug-in to a normal synchronization application such as ActiveSync, available via a browser plug-in running on the plug-in provider's website, and/or other sources. The user may log into the application and verify their identity, and in response to verification, the application may allow access to a devices section in the device management application. The device management application may read the transaction card **112** and display the MAC addresses, signatures of the devices that he has inserted his plug-in to, and/or other device specific information. The mobile device **110** may be marked as active and the host device may be shown as disallowed or inactive. The application may enable the user to update the status of the new host device, and in response to at least the selection, the device management application may install the signature on the new host device and mark update the status as allowable in secure memory of the transaction card **112**. The user may be able to also update the status of the mobile device **110** to disallowed. Otherwise, both devices may be active and the transaction card **112** may be switched between the two devices. In regards to the hardware reset process, the use may use the reset needle point press on the physical transaction card **112** to activate the self-train mode. In this mode, the financial data may be deleted and have to be reloaded. When the transaction card **112** is inserted into the new host device, the provisioning process may begin as discussed above.

The POS **114** can include any software, hardware, and/or firmware that receives from the transaction card **112** account information for executing a transaction with one or more financial institutions **106**. For example, the POS **114** may be an electronic cash register capable of wirelessly communicating transaction information with the transaction card **112***a*. The POS **114** may communicate transaction information associated with traditional contact payment methods such as plastic cards and checks. If enabled for wireless/contactless payment transactions, the POS **114** may communicate information with the transaction card **112** in one or more the following formats: 14443 Type A/B, Felica, MiFare, ISO

18092, ISO 15693; and/or others. The transaction information may include verification information, check number, routing number, account number, transaction amount, time, driver's license number, merchant ID, merchant parameters, credit-card number, debit-card number, digital signature and/or other information. In some implementations, the transaction information may be encrypted. In illustrated implementation, the POS **114** can wirelessly receive encrypted transaction information from the transaction card **112** and electronically send the information to one or more of the financial institutions **106** for authorization. For example, the POS **114** may receive an indication that a transaction amount has been accepted or declined for the identified account and/or request additional information from the transaction card **112**.

As used in this disclosure, the client **104** are intended to encompass a personal computer, touch screen terminal, workstation, network computer, a desktop, kiosk, wireless data port, smart phone, PDA, one or more processors within these or other devices, or any other suitable processing or electronic device used for viewing transaction information associated with the transaction card **112**. For example, the client **104** may be a PDA operable to wirelessly connect with an external or unsecured network. In another example, the client **104** may comprise a laptop that includes an input device, such as a keypad, touch screen, mouse, or other device that can accept information, and an output device that conveys information associated with transactions executed with the financial institutions **106**, including digital data, visual information, or GUI **115**. In some implementations, the client **104***b* can wirelessly communicate with the transaction card **112***b* using, for example, an NFC protocol. In some implementations, the client **104***a* includes a card reader **116** having a physical interface for communicating with the transaction card **112***c*. In some implementations, the card reader **116** may at least include an adapter **116***b* that adapts the interface supported by the client **104** (e.g., USB, Firewire, Bluetooth, WiFi) to the physical interface supported by the card **112** (e.g., SD/NFC). In this case, the client **104***a* may not include a transceiver for wireless communication.

The GUI **115** comprises a graphical user interface operable to allow the user of the client **104** to interface with at least a portion of the system **100** for any suitable purpose, such as viewing transaction information. Generally, the GUI **115** provides the particular user with an efficient and user-friendly presentation of data provided by or communicated within the system **100**. The GUI **115** may comprise a plurality of customizable frames or views having interactive fields, pull-down lists, and/or buttons operated by the user. The term graphical user interface may be used in the singular or in the plural to describe one or more graphical user interfaces and each of the displays of a particular graphical user interface. The GUI **115** can include any graphical user interface, such as a generic web browser or touch screen, that processes information in the system **100** and presents the results to the user. The financial institutions **106** can accept data from the client **104** using, for example, the web browser (e.g., Microsoft Internet Explorer or Mozilla Firefox) and return the appropriate responses (e.g., HTML or XML) to the browser using the network **108**. In some implementations, the GUI **111***c* of the transaction card **112***c* may be presented through the GUI **115***a* of the client **104***a*. In these implementations, the GUI **115***a* may retrieve user credentials from the GUI **111***c* and populate financial forms presented in the GUI **115***a*. For example, the GUI **115***a* may present a forum to the user for entering credit card information to purchase a good through the Internet, and the GUI **115***a* may populate the form using the GUI **111***c* in response to at least a request from the user.

Financial institutions **106***a-c* can include any enterprise that may authorize transactions received through the network **108**. For example, the financial institution **106***a* may be a credit card provider that determines whether to authorize a transaction based, at least in part, on information received through the network **106**. The financial institution **106** may be a credit card provider, a bank, an association (e.g., VISA), a retail merchant (e.g., Target), a prepaid/gift card provider, an internet bank, and/or others. In general, the financial institution **106** may execute one or more of the following: receive a request to authorize a transaction; identify an account number and other transaction information (e.g., PIN); identify funds and/or a credit limit associated with the identified account; determine whether the transaction request exceeds the funds and/or credit limit and/or violates any other rules associated with the account; transmit an indication whether the transaction has been accepted or declined; and/or other processes. In regards to banking, the financial institution **106** may identify an account number (e.g., bank account, debit-card number) and associated verification information (e.g., PIN, zip code) and determine funds available to the account holder. Based, at least in part, on the identified funds, the financial institution **106** may either accept or reject the requested transaction or request additional information. As for encryption, the financial institution **106** may use a public key algorithm such as RSA or elliptic curves and/or private key algorithms such as TDES to encrypt and decrypt data.

Network **108** facilitates wireless or wired communication between the financial institutions and any other local or remote computer, such as clients **104** and the POS device **114**. Network **108** may be all or a portion of an enterprise or secured network. While illustrated as single network, network **108** may be a continuous network logically divided into various sub-nets or virtual networks without departing from the scope of this disclosure, so long as at least a portion of network **108** may facilitate communications of transaction information between the financial institutions **106**, the clients **104**, and the offline store **102**. In some implementations, network **108** encompasses any internal or external network, networks, sub-network, or combination thereof operable to facilitate communications between various computing components in system **100**. Network **108** may communicate, for example, Internet Protocol (IP) packets, Frame Relay frames, Asynchronous Transfer Mode (ATM) cells, voice, video, data, and other suitable information between network addresses. Network **108** may include one or more local area networks (LANs), radio access networks (RANs), metropolitan area networks (MANs), wide area networks (WANs), all or a portion of the global computer network known as the Internet, and/or any other communication system or systems at one or more locations.

FIG. **2** is a block diagram illustrating an example transaction system **200** for wirelessly communicating transactions information using cellular radio technology. For example, the system **200** may wirelessly communicate a transaction receipt to a transaction card **112** using a mobile host device **110** and cellular radio technology. In some implementations, cellular radio technology may include Global System for Mobile Communication (GSM), Code Division Multiple Access (CDMA), Universal Mobile Telecommunications System (UMTS), and/or any other cellular technology. The financial institutions **106** may assign one or more mobile host devices **110** to a transaction card **112** in response to one or more events. In some examples, the user may register the one or more mobile devices **110** with the financial institution **106** in connection with, for example, requesting the associated transaction card **112**. In some examples, the transaction card **112** may register the mobile host device **110** with the financial institution **106** in response to at least an initial insertion into the device **110**. Regardless of the association process, the system **100** may use the cellular capabilities of the host devices **110** to communicate information between the financial institutions **106** and the transaction card **112**. In using the cellular radio technology of the host device **110**, the system **100** may communicate with the transaction card **112** when the card **112** is not proximate a retail device, such as the POS device **114** of FIG. **1**.

In the illustrated implementation, the cellular core network **202** typically includes various switching elements, gateways and service control functions for providing cellular services. The cellular core network **202** often provides these services via a number of cellular access networks (e.g., RAN) and also interfaces the cellular system with other communication systems such as the network **108** via a MSC **206**. In accordance with the cellular standards, the cellular core network **202** may include a circuit switched (or voice switching) portion for processing voice calls and a packet switched (or data switching) portion for supporting data transfers such as, for example, e-mail messages and web browsing. The circuit switched portion includes MSC **206** that switches or connects telephone calls between radio access network (RAN) **204** and the network **108** or another network, between cellular core networks or others. In case the core network **202** is a GSM core network, the core network **202** can include a packet-switched portion, also known as General Packet Radio Service (GPRS), including a Serving GPRS Support Node (SGSN) (not illustrated), similar to MSC **206**, for serving and tracking communication devices **102**, and a Gateway GPRS Support Node (GGSN) (not illustrated) for establishing connections between packet-switched networks and communication devices **110**. The SGSN may also contain subscriber data useful for establishing and handing over call connections. The cellular core network **202** may also include a home location register (HLR) for maintaining "permanent" subscriber data and a visitor location register (VLR) (and/or an SGSN) for "temporarily" maintaining subscriber data retrieved from the HLR and up-to-date information on the location of those communications devices **110** using a wireless communications method. In addition, the cellular core network **202** may include Authentication, Authorization, and Accounting (AAA) that performs the role of authenticating, authorizing, and accounting for devices **110** operable to access GSM core network **202**. While the description of the core network **202** is described with respect to GSM networks, the core network **202** may include other cellular radio technologies such as UMTS, CDMA, and others without departing from the scope of this disclosure.

The RAN **204** provides a radio interface between mobile devices and the cellular core network **202** which may provide real-time voice, data, and multimedia services (e.g., a call) to mobile devices through a macrocell **208**. In general, the RAN **204** communicates air frames via radio frequency (RF) links. In particular, the RAN **204** converts between air frames to physical link based messages for transmission through the cellular core network **202**. The RAN **204** may implement, for example, one of the following wireless interface standards during transmission: Advanced Mobile Phone Service (AMPS), GSM standards, Code Division Multiple Access (CDMA), Time Division Multiple Access (TDMA), IS-54 (TDMA), General Packet Radio Service (GPRS), Enhanced Data Rates for Global Evolution (EDGE), or proprietary radio interfaces. Users may subscribe to the RAN **204**, for example, to receive cellular telephone service, Global Positioning System (GPS) service, XM radio service, etc.

The RAN **204** may include Base Stations (BS) **210** connected to Base Station Controllers (BSC) **212**. BS **210** receives and transmits air frames within a geographic region of RAN **204** (i.e. transmitted by a cellular device **102***e*) and communicates with other mobile devices **110** connected to the GSM core network **202**. Each BSC **212** is associated with one or more BS **210** and controls the associated BS **210**. For example, BSC **212** may provide functions such as handover, cell configuration data, control of RF power levels or any other suitable functions for managing radio resource and routing signals to and from BS **210**. MSC **206** handles access to BSC **212** and the network **108**. MSC **206** may be connected to BSC **212** through a standard interface such as the A-interface. While the elements of RAN **204** are describe with respect to GSM networks, the RAN **204** may include other cellular technologies such as UMTS, CDMA, and/or others. In the case of UMTS, the RAN **204** may include Node B and Radio Network Controllers (RNC).

The contactless smart card **214** is a pocket-sized card with embedded integrated circuits that process information. For example, the smart card **214** may wirelessly receive transaction information, process the information using embedded applications and wirelessly transmit a response. The contactless smart card **214** may wirelessly communicate with card readers through RFID induction technology at data rates of 106 to 848 kbit/s. The card **214** may wirelessly communicate with proximate readers between 10 cm (e.g., ISO/IEC 14443) to 50 cm (e.g., ISO 15693). The contactless smart card **214** operates independent of an internal power supply and captures energy from incident radio-frequency interrogation signals to power the embedded electronics. The smart card **214** may be a memory card or microprocessor card. In general, memory cards include only non-volatile memory storage components and may include some specific security logic. Microprocessor cards include volatile memory and microprocessor components. In some implementations, the smart card **214** can have dimensions of normally credit card size (e.g., 85.60×53.98×0.76 mm, 5×15×0.76 mm). In some implementations, the smart card **214** may be a fob or other security token. The smart card **214** may include a security system with tamper-resistant properties (e.g., a secure cryptoprocessor, secure file system, human-readable features) and/or may be configured to provide security services (e.g., confidentiality of stored information).

In some aspects of operation, the financial institution **106** may use the mobile host device **110** to communicate information to the transaction card **112**. For example, the financial institution **106** may wirelessly communicate with the mobile host device **110** using the cellular core network **202**. In some implementations, the financial institution **106** may transmit information to the mobile host device **110** in response to at least an event. The information may include, for example, transaction information (e.g., transaction receipt, transaction history), scripts, applications, Web pages, and/or other information associated with the financial institutions **106**. The event may include completing a transaction, determining a transaction card **112** is outside the operating range of a POS terminal, receiving a request from a user of the mobile host device, and/or others. For example, the financial institution **106** may identify a mobile host device **110** associated with a card **112** that executed a transaction and transmit transaction information to the mobile host device **110** using the cellular core network **202**. In using the cellular core network **202**, the financial institutions **106** may transmit information to the transaction card **112** without requiring a POS terminal being proximate to the card **112**. In addition or alternatively, the financial institution **106** may request information from the mobile host device **110**, the transaction card **112** and/or the user using the cellular core network **202**. For example, the financial institution **106** may transmit a request for transaction history to the card **112** through the cellular core network **202** and the mobile host device **110**.

In some aspects of operation, a merchant or other entity may operate the mobile host device **110***c* as a mobile POS terminal configured to wirelessly execute transactions with the smart card **214**. For example, a vendor may be mobile (e.g., a taxi driver) and may include a mobile host device **110***c* with a transaction card **112***c*. In this example, the transaction card **112***c* may wirelessly receive account information from the smart card **214** and the POS **114** may transmit an authorization request to the financial institution **106** using the mobile host device **110** and the cellular core network **202**. In response to at least the request, the financial institution **106** may generate an authorization response to the transaction card **112***c* using the mobile host device **110** and the cellular network **202**.

In some implementations, the system **100** may execute one or more of the modes discussed with respect to FIG. **1**. For example, the transaction card **112** may be re-personalized/updated using the cellular radio technology of the mobile host device **110**. The user may want to re-personalize the transaction card **112** to change host devices, to have multiple host devices, and/or other reasons. In regards to the software device management, the user may transmit to the financial institution **106** a request to re-personalize the transaction card **112** using the cellular radio technology of the host device **110**.

FIG. **3** illustrates is a block diagram illustrating an example transaction card **112** of FIG. **1** in accordance with some implementations of the present disclosure. In general, the transaction card **112** includes personalized modules that execute financial transactions independent of the mobile device **110**. The illustrated transaction card **112** is for example purposes only, and the transaction card **112** may include some, all or different modules without departing from the scope of this disclosure.

In some implementations, the transaction card **112** can include an interface layer **302**, an API/UI **304**, a Web server **306**, a real-time framework **308**, payment applications **310**, value added applications **312**, user credentials **314**, real-time OS **316**, contactless chipset **318**, antenna control functions **320**, antenna **322**, bank used memory **324**, and free memory **326**. In some implementations, a host controller includes the interface layer **302**, he API/UI **304**, the Web server **306**, the real-time framework **308**, the contactless chipset **318**, and the antenna control functions **320**. In some implementations, a security module includes the payment applications **310** and the user credentials **314**. The bank used memory **324** and free memory **326** may be contained in Flash. In some implementations, the contactless chipset **318** may be integrated within the security module or operated as a standalone. The antenna **322** may be electronic circuitry.

The interface layer **302** includes interfaces to both the host device, i.e., physical connection, and the external world, i.e., wireless/contactless connection. In payment implementations, the wireless connection can be based on any suitable wireless standard such as contactless (e.g., ISP 14443 A/B), proximity (e.g., ISO 15693), NFC (e.g., ISO 18092), and/or others. In some implementations, the wireless connection can use another short range wireless protocol such as Bluetooth, another proprietary interfaces used by retail payment terminals (Felica in Japan, MiFare in Asia, etc.), and/or others. In regards to the physical interface, the interface layer **302** may physically interface the mobile device **110** using an SD protocol such as MicroSD, Mini-SD or SD (full-size). In some implementations, the physical interface may include a converter/adapter to convert between two different protocols based, at least in part, on the mobile device **110**. In some implementations, the mobile device **110** may communicate using protocols such as USB, MMC, iPhone proprietary interface, or others.

The API/UI layer **304** can include any software, hardware, and/or firmware that operates as an API between the mobile device **110** and the transaction card **112** and as the GUI **111**. Prior to executing transactions, the transaction card **112** may automatically install drivers in the mobile device **110** in response to at least insertion. For example, the transaction card **112** may automatically install a MicroSD device driver in the device **110** to enable the transaction card **112** to interface the mobile device **110**. In some implementations, the transaction card **112** may install an enhanced device driver such as a Mass Memory with Radio (MMR) API. In this implementation, the interface can drive a class of plug-ins that contain mass memory as well as a radio interface. The MMR API may execute one or more of the following: connect/disconnect to/from the MMR controller (Microcontroller in the plug-in); transfer data using MM protocol (e.g., SD, MMC, XD, USB, Firewire); send encrypted data to the MMR controller; receive Acknowledgement of Success or Error; received status word indicating description of error; turn radio on/off; send instruction to the transaction card **112** to turn the antenna on with specifying the mode of operation (e.g., sending mode, listening mode); transmit data such as send instruction to controller to transmit data via the radio; listen for data such as send instruction to controller to listen for data; read data such as send instruction to controller to send the data received by the listening radio; and/or others. In some implementations, MMR can be compliant with TCP/IP. In some implementations, API encapsulated ISO 7816 commands may be processed by the security module in addition to other commands.

In some implementations, the API can operate in accordance with the two processes: (1) the transaction card **112** as the master and the mobile device **110** as the slave; and (2) the card UI as the master. In the first process, the transaction card **112** may pass one or more commands to the mobile device **110** in response to, for example, insertion of the transaction card **112** into a slot in the mobile device **110**, a transaction between the transaction card **112** and the POS **114**, and/or other events. In some implementations, the transaction card **112** can request the mobile device **110** to execute one or more of following functions: Get User Input; Get Signature; Display Data; Send Data; Receive Data; and/or others. The Get User Input command may present a request through the GUI **111** for data from the user. In some implementations, the Get User Input may present a request for multiple data inputs. The data inputs may be any suitable format such as numeric, alphanumeric, and/or other strings of characters. The Get Signature command may request the mobile device **110** to return identification data such as, for example, a phone number, a device ID like an IMEI code or a MAC address, a network code, a subscription ID like the SIM card number, a connection status, location information, Wi-Fi beacons, GPS data, and/or other device specific information. The Display Data command may present a dialog to the user through the GUI **111**. In some implementations, the dialog can disappear after a period of time, a user selection, and/or other event. The Send Data command may request the mobile device **110** to transmit packet data using its own connection to the external world (e.g., SMS, cellular, Wi-Fi). The Receive Data command may request the mobile device **110** to open a connection channel with certain parameters and identify data received through the connection. In some implementations, the command can request the mobile device **110** to forward any data (e.g., SMS) satisfying certain criteria to be forwarded to the transaction card **112**.

In regards to the UI as master, the UI may execute one or more of the following commands: security module Command/Response; Activate/Deactivate; Flash Memory Read/Write; Send Data with or without encryption; Receive Data with or without decryption; URL Get Data/URL Post Data; and/or others. The security module commands may relate to security functions provided by the card and are directed towards the security module within the transaction card **112** (e.g., standard ISO 7816 command, proprietary commands). In some implementations, the commands may include encryption, authentication, provisioning of data, creation of security domains, update of security domain, update of user credentials after verification of key, and/or others. In some implementations, the commands may include non security related smart card commands such as, for example, read transaction history commands. The read transaction history command may perform a read of the secure memory **324** of the transaction card **112**. In some implementations, certain flags or areas of the secure memory **324** may be written to after security verification. The Activate/Deactivate command may activate or deactivate certain functions of the transaction card **112**. The Flash Memory Read/Write command may execute a read/write operation on a specified area of the non-secure memory **326**. The Send Data with or without encryption command may instruct the transaction card **112** to transmit data using its wireless connection with, for example, the POS **114**. In addition, the data may be encrypted by the transaction card **112** prior to transmission using, for example, keys and encryption capability stored within the security module. The Receive Data with or without decryption command may instruct the transaction card **112** to switch to listening mode to receive data from its wireless connection with the terminal/reader (e.g., POS **114**). In some implementations, data decryption can be requested by the security module using, for example, keys and decryption algorithms available on the security module, i.e., on-board decryption. The URL Get Data/URL Post Data command may instruct the web server **306** to return pages as per offline get or post instructions using, for example, offline URLs.

The Web server **306**, as part of the OS of the transaction card **112**, may assign or otherwise associate URL style addressing to certain files stored in the memory **326** (e.g., flash) of the transaction card **112**. In some implementations, the Web server **306** locates a file using the URL and returns the file to a browser using standard HTTP, HTTPS style transfer. In some implementations, the definition of the files can be formatted using standard HTML, XHTML, WML and/or XML style languages. The file may include links that point to additional offline storage locations in the memory **326** and/or Internet sites that the mobile device **110** may access. In some implementations, the Web server **306** may support security protocols such as SSL. The Web server **306** may transfer an application in memory **326** to the mobile device **111** for installation and execution. The Web server **306** may request the capabilities of the browser on the device **110** using, for example, the browser user agent profile, in order to customize the offline Web page according to the supported capabilities of the device and the browser, such as, for example, supported markup language, screen size, resolution, colors and such.

As part of the Real time OS, the real-time framework **308** may execute one or more functions based, at least in part, on one or more periods of time. For example, the real-time framework **308** may enable an internal clock available on the CPU to provide timestamps in response to at least requested events. The real-time framework **308** may allow certain tasks to be pre-scheduled such that the tasks are executed in response to at least certain time and/or event based triggers. In some implementations, the real-time framework **308** may allow the CPU to insert delays in certain transactions. In some implementation, a part of WAP standards called WTAI (Wireless Telephoney Application Interface) can be implemented to allow offline browser pages on the card **112** to make use of functions offered by the mobile device **110** (e.g., send/receive wireless data, send/receive SMS, make a voice call, play a ringtone etc.).

The payment applications **310** can include any software, hardware, and/or firmware that exchanges transaction information with the retail terminal using, in some instances, a pre-defined sequence and/or data format. For example, the payment applications **310** may generate a response to a transaction request by selecting, extracting or otherwise including user credentials in the response, in a format compatible with the retail terminal's payment processing application. In some implementations, the payment applications **310** may execute one or more of the following: transmit properties of the transaction card **112** in response to at least an identification request received from the POS **114**; receive a request to execute a transaction from, for example, the POS **114**; identify user credentials in the bank-used memory **324** in response to at least the request; generate a transaction response based, at least in part, on the user credentials; transmit the transaction response to the POS **114** using, for example, a contactless chipset; receive clear data, for example a random number, from the POS **114** and provide a response containing encrypted data by encrypting the clear data using the cryptographic capabilities of the secure element; transmit the encrypted data using the contactless chipset **318**; increment a transaction counter with every transaction request received; transmit a value of the transaction counter in response to a request from the POS **114**; store details of the transaction request received from the POS **114** into the transaction history area of the bank used memory **324**; transmit transaction history to the CPU of the intelligent card **112** in response to such a request; receive ISO 7816 requests from the CPU of the intelligent card **112**; execute corresponding transactions using the secure element OS; provide responses back to the CPU; and/or other processes. In generating the transaction response, the payment application **310** may generate the response in a format specified by the payment network (VISA, MasterCard, Amex, Discover) associated with a financial institution **106** or a proprietary format owned and defined by the financial institution **106** and processible by the POS **114**. The transaction request may include one or more of the following: user credentials (e.g., account number); expiry data, card verification numbers; a transaction count; and/or other card or user information. In some implementations, the payment application **310** may comprises a browser application to enable transactions. The browser application **310** may be a browser that may be installed if the device **110** is either missing a browser or has a browser that is incompatible with the Web server **306** on the card **112**. After installation of such browser **310**, future communications between the mobile device **110** and the web-server **306** make use the newly installed browser.

The real-time OS **316** may execute or otherwise include one or more of the following: real-time framework **308**; a host process that implements the physical interface between the transaction-card CPU and the mobile device **110**; an interface that implements the physical interface between the transaction-card CPU and the security module; a memory-management process that implements the ISO 7816 physical interface between the transaction-card CPU and the memory **324** and/or **326**; an application-layer process that implements the API and UI capabilities; the Web server **306**; antenna-control functions **320**; power management; and/or others. In some implementations, the real-time OS **316** may manage the physical interface between the transaction-card CPU and the secure memory **324** that includes memory segmentation to allow certain memory areas to be restricted access and/or data buffers/pipes. In some implementations, the security module can include a security module OS provided by the security module Vendor and may be compliant with Visa and MasterCard specifications. The security module OS may structure the data in the security module to be compliant with Paypass and/or payWave specifications or any other available contactless retail payment industry specifications. In addition, the security module may store host device signatures and allow modes of the antenna **322** in the secure element **324**. In some implementations, the real-time OS **316** may include a microcontroller OS configured to personalizing the secure element **324** such as by, for example, converting raw FV data (account number, expiry date, Card Verification Number (CVN), other application specific details) into secure encrypted information. In addition, the microcontroller OS may present the card **112** as a MicroSD mass storage to the host device. The microcontroller OS may partition the memory into a user section and a protected device application section. In this example, the device application section may be used to store provider specific applications that either operate from this segment of the memory or are installed on the host device from this segment of the memory.

The security module chip may provide tamper-resistant hardware security functions for encryption, authentication, management of user credentials using multiple security domains, on-board processing capabilities for personalization, access and storage, and/or others. In some implementations, the security module chip can include the contactless chipset **318**.

The contactless chipset **318** may provides the hardware protocol implementation and/or drivers for RF communication. For example, the contactless chipset **318** may include on-board RF circuitry to interface with an external world connection using a wireless/contactless connection. The wireless connection may be, for example, client to node (terminal/reader/base station), node to client (passive tag), or peer to peer (another transaction card **112**).

The antenna control function **320** may controls the availability of the RF antenna. For example, the antenna control function **320** may activate/deactivate the antenna **322** in response to, for example, successful authentication, completion of a routine established by the OS **316**, and/or other event. The antenna **322** may be a short range wireless antenna connected to an NFC inlay via a software switch such as a NAND Gate or other element.

FIG. **4** is a block diagram illustrating an example intelligent card **400** in accordance with some implementations of the present disclosure. For example, the transaction card of FIG. **1** may be implemented in accordance with the illustrated intelligent card **400**. In general, the intelligent card **400** may independently access services and/or transactions. The intelligent card **400** is for illustration purposes only and may include some, all, or different elements without departing from the scope of the disclosure.

As illustrated, the intelligent card **400** includes an antenna **402**, a switch plus tuning circuit **404**, a security module and contactless chipset **406**, a CPU **408** and memory **410**. The antenna **402** wirelessly transmits and receives signals such as NFC signals. In some implementations, the switch plus tuning circuit **404** may dynamically adjust the impedance of the antenna **402** to tune the transmit and/or receive frequency. In addition, the switch plus tuning circuit **404** may selectively switch the antenna **402** on and off in response to at least a command from the CPU **408**. In some implementations, the antenna **402** can be a short range wireless antenna connected to an NFC inlay via a software switch such as an NAND Gate or other element to allow for code from the CPU **408** to turn the antenna **402** on and off In some implementations, the card **400** may include an NFC inlay (not illustrated) that can be a passive implementation of NFC short range wireless technology deriving power from the reader terminal in order to transmit data back or a stronger implementation using an eNFC chipset to power active reader mode and self-train mode. In addition, the card **400** may include an external needle point reset (not illustrated) that prompts the CPU **408** to depersonalize the memory or secure element.

The CPU **408** may transmit the switching command in response to an event such as a user request, completion of a transaction, and/or others. When switched on, the security chip and contactless chipset **406** is connected to the antenna **402** and executes one or more of the following: format signals for wireless communication in accordance with one or more formats; decrypt received messages and encrypt transmitted messages; authenticate user credentials locally stored in the memory **410**; and/or other processes. The memory **410** may include a secure and non-secured section. In this implementation, the secure memory **410** may store one or more user credentials that are not accessible by the user. In addition, the memory **410** may store offline Web pages, applications, transaction history, and/or other data. In some implementations, the memory **410** may include Flash memory from 64 MB to 32 GB. In addition, the memory **410** may be partitioned into user memory and device application memory. The chipset **406** may include a security module that is, for example Visa and/or MasterCard certified for storing financial vehicle data and/or in accordance with global standards. In addition to a user's financial vehicle, the secure element may store signatures of allowed host devices and/or antenna modes.

In some implementations, the CPU **408** may switch the antenna **402** between active and inactivate mode based, at least in part, on a personalization parameter defined by, for example, a user, distributor (e.g., financial institution, service provider), and/or others. For example, the CPU **408** may activate the antenna **402** when the intelligent card **400** is physically connected to a host device and when a handshake with the host device is successfully executed. In some implementations, the CPU **408** may automatically deactivate the antenna **402** when the intelligent card **400** is removed from the host device. In some implementations, the antenna **402** is always active such that the intelligent card **400** may be used as a stand-alone access device (e.g., device on a keychain). In regards to the handshaking process, the CPU **408** may execute one or more authentication processes prior to activating the intelligent card **400** and/or antenna **402** as illustrated in FIG. **7**. For example, the CPU **408** may execute a physical authentication, a device authentication, and/or a user authentication. For example, the CPU **408** may activate the antenna **402** in response to at least detecting a connection to the physical interface with the host device (e.g., SD interface) and successful installation of the device driver for mass memory access (e.g., SD device driver) on the host device. In some implementations, device authentication may include physical authentication in addition to a signature comparison of a device signature stored in memory (e.g., security module (SE)) that was created during first-use (provisioning) to a run-time signature calculated using, for example, a unique parameter of the host device. In the event no host device signature exists in the memory, the CPU **408** may bind with the first compatible host device the card **400** is inserted into. A compatible host device may be a device that can successfully accomplish physical authentication successfully. If a host-device signature is present in the memory, the CPU **408** compares the stored signature with the real-time signature of the current host device. If the signatures match, the CPU **408** may proceed to complete the bootstrap operation. If the signatures do not match, host device is rejected, bootstrap is aborted and the card **400** is returned to the mode it was before being inserted into the device.

User authentication may include verification of physical connection with a user using a PIN entered by the user, a x.509 type certificate that is unique to the user and stored on the host device, and/or other processes. Device and user authentication may verify a physical connection with device through comparison of a device signature and user authentication through verification of user PIN or certificate. In some implementations, the user can select a PIN or certificate at provisioning time. If this case, the CPU **408** may instantiate a software plug-in on the host device. For example, a software plug-in may request the user for his PIN in real time, read a user certificate installed on the device (e.g., x.509), and/or others. The operation of the software plug-in may be customized by the provider. Regardless, the returned user data may be compared with user data stored in the memory. In case of a successful match, the antenna **402** may be activated. In case of an unsuccessful match of a certificate, then card **400** is deactivated. In case of unsuccessful PIN match, the user may be requested to repeat PIN attempts until a successful match or the number of attempts exceeds a threshold. The disk provider may customize the attempt threshold.

In regards to network authentication, the host device may be a cellphone such that the card **400** may request network authentication prior to activation. For example, the card **400** may be distributed by a Wireless Network Operator (WNO) that requires a network authentication. In this example, a flag in memory may be set to ON indicating that network authentication is required. If the flag is set to ON, a unique identity about the allowed network is locally stored in memory such a Mobile Network Code for GSM networks, a NID for CDMA networks, a SSID for broadband networks, and/or identifiers. If this flag is ON, the CPU **408** in response to at least insertion may request a special software plug-in to be downloaded to the host device and instantiated. This software plug-in may query the host device to respond with network details. In some cases, the type of unique network identity employed and the method to deduce it from the host device may be variable and dependent on the network provider and capability of the host device. If the locally-stored ID matches the request ID, the CPU **408** activated the antenna **402** to enable access or otherwise services are denied.

FIGS. **5**A and **5**B illustrate an example transaction card **112** in accordance with some implementations of the present disclosure. In the illustrated implementation, the transaction card **112** includes a shape and dimensions exactly the same or substantially similar to a standard MicroSD card. The transaction card **112** includes an antenna **502** for wirelessly communicating with, for example, retail terminals (e.g., POS **114**) using RF signals and an SD interface **506** for physically interfacing a device (e.g., mobile device **110**). The antenna **502** may be a flat coil (e.g., copper coil) integrated on one or more layers the MicroSD transaction card **112**, a printed circuit (e.g., copper circuit) etched on one or more layers of the MicroSD transaction card **112**, and/or other configuration for wirelessly transmitting and receiving RF signals. In some implementations, the antenna **502** may be substantially planar and adjacent at least a portion of the housing **508** of the transaction card **112** (e.g., top, bottom). The antenna **502** may include a width of at least approximately 9 mm and a length of at least approximately 14 mm. As illustrated in FIG. **5**B, the antenna **502** is connected to a transaction circuit **510** (e.g., a contactless chipset) using, for example, a tuning circuit that tunes the antenna **502** to one or more frequencies. The one or more frequencies may be based, at least in part, on the terminal and/or type of terminal (e.g., POS **114**). For example, the tuning circuit may tune the antenna **502** to 13.56 MHz for ISO 14443 related transactions. In some implementations, the antenna **502** may include insulation to substantially prevent signals from interfering with the circuit **510**, mobile device **110**, battery elements, and/or other elements that may be proximate to the transaction card **112**. The transaction card **112** may include an amplifier circuit **504** to amplify (e.g., a factor of 10) signals generated by the antenna **502**. In some implementations, the amplifier **504** may be of two types. For example, the amplifier **504** may be a passive amplifier that uses passive circuitry to amplify the RF signals received by the antenna (see FIGS. **13**A and **13**B) and/or a powered active amplifier that uses the energy from the battery of the host device to operate the transaction circuit (see FIG. **14**A and FIG. **14**B). In some implementations, the transaction card **112** may contain two additional RF interface pins **509**A and **509**B to allow the transaction card to use an external antenna, for example, an antenna contained in a separate housing for transactions and/or personalization.

FIGS. **6**A and **6**B illustrate another example of the transaction card **112** in accordance with some implementations of the present disclosure. In the illustrated implementation, the transaction card **112** includes a three-dimensional antenna **602**. For example, the antenna **602** may include a shape that is substantially helical such as a three-dimensional antenna coil. In addition, the transaction card **112** may include a housing **608** enclosing the antenna **602** and a transaction circuit **610**. As illustrated in FIG. **6**B, the antenna **602** may include a core **608** that substantially defines a length and a width of a three-dimensional shape of the antenna **602**. In some implementations, the core **608** may comprise a middle segment of the transaction card **112** such that the width of the antenna coil **602** is substantially similar to the transaction card **112**. The core **608** may reflect at least some wireless signals to substantially isolate the magnetic field from the transaction circuit **610**, the mobile device **110**, battery elements, and/or other elements proximate the antenna **602** in such a way that the magnetic field is concentrated in a direction substantially pointing away from the host device. The illustrated antenna **602** can be connected to the transaction circuit **610** (e.g., contactless chipset). In some implementations, the antenna **602** may be connected to a tuning circuit that substantially tunes the antenna **602** to one or more frequencies compatible with, for example, a retail terminal **114**. For example, the tuning circuit may tune the antenna **602** to 13.56 MHz for ISO 14443 related transactions. The transaction card **112** may include an amplifier circuit **604** to amplify (e.g., a factor of 10) wireless signals generated by the antenna **602**. In some implementations, the amplifier **604** may be of two types. For example, the amplifier **604** may be a passive amplifier that uses passive circuitry to amplify the RF signals received by the antenna (see FIGS. **13**A and **13**B) and/or a powered active amplifier that uses the energy from the battery of the host device to operate the transaction circuit (see FIG. **14**A and FIG. **14**B).

FIGS. **7**A and **7**B illustrate an example transaction card **112** including an external antenna **702** in accordance with some implementations of the present disclosure. In the illustrated implementation, the transaction card **112** can include an antenna **702** enclosed in a resilient member **704** and external to a housing **706** of the transaction card **112**. The antenna **702** and the resilient member **704** may extend outside the SD slot during insertion of the housing **706**. In some cases, the housing **706** may be substantially inserted into the slot of the device (e.g., mobile device **110**). In the illustrated implementation, the housing **706** can include a shape and dimensions exactly the same or substantially similar to a standard MicroSD card. The antenna **702** wirelessly communicates with, for example, retail terminals (e.g., POS **114**) using RF signals. In addition, the transaction card **112** may include an SD interface **710** for physically interfacing a device (e.g., mobile device **110**). The antenna **702** may be a substantially planar coil (e.g., copper coil) integrated into one or more layers, a printed circuit (e.g., copper circuit) etched into one or more layers, and/or other configuration for wirelessly transmitting and receiving RF signals. The enclosed antenna **702** and the housing **706** may form a T shape. In some implementations, the antenna **702** may be substantially planar and adjacent at least a portion of the housing **708** of the transaction card **112** (e.g., top, bottom). The antenna **702** may include a width in the range of approximately 9 mm and a length in the range of approximately 14 mm. The resilient member **704** may be rubber, foam, and/or other flexible material. In some implementations, a flat, cylindrical or other shaped block of ceramic antenna may be used instead of the resilient member **704** and antenna **702**. As illustrated in FIG. **7**B, the antenna **702** is connected to a transaction circuit **710** (e.g., a contactless chipset) using, for example, a tuning circuit that tunes the antenna **702** to one or more frequencies. The one or more frequencies may be based, at least in part, on the terminal and/or type of terminal (e.g., POS **114**). For example, the tuning circuit may tune the antenna **702** to 13.56 MHz for ISO 14443 related transactions. In some implementations, the antenna **702** may include insulation using material (e.g., Ferrite) to substantially isolate and direct magnetic field signals away from interfering with the circuit **710**, mobile device **110**, battery elements, and/or other elements that may be proximate to the transaction card **112** in such a way that the magnetic field is concentrated in a direction substantially pointing away from the host device slot in which the transaction card is inserted. The transaction card **112** may include an amplifier circuit **712** to amplify (e.g., a factor of 10) signals generated by the antenna **702**. In some implementations, the amplifier **712** may be of two types. For example, the amplifier **712** may be a passive amplifier that uses passive circuitry to amplify the RF signals received by the antenna (see FIGS. **13**A and **13**B) and/or a powered active amplifier that uses the energy from the battery of the host device to operate the transaction circuit (see FIG. **14**A and FIG. **14**B).

FIGS. **8**A-C illustrate an example transaction card **112** including an external three-dimensional antenna **802** in accordance with some implementations of the present disclosure. In the illustrated implementation, the transaction card **112** can include an antenna **802** enclosed in a resilient member **804** and external to a housing **806** of the transaction card **112**. The antenna **802** and the resilient member **804** may extend outside the SD slot receiving the housing **806**. In some cases, the housing **806** may be substantially inserted into the slot of the device (e.g., mobile device **110**). In the illustrated

implementation, the housing **806** can include a shape and dimensions exactly the same or substantially similar to a standard MicroSD card. The antenna **802** wirelessly communicates with, for example, retail terminals (e.g., POS **114**) using RF signals. In addition, the transaction card **112** may include an SD interface **808** for physically interfacing a device (e.g., mobile device **110**). The member **804** may include an arcuate outer surface and/or a substantially flat surface that abuts a portion of the housing **806**. As illustrated in FIG. **8**C, the antenna **802** may include a core **810** that substantially defines a length and a width of a three-dimensional shape of the antenna **802**. The core **810** may reflect at least some wireless signals to substantially isolate the magnetic field from the transaction card **112**, the mobile device **110**, battery elements, and/or other elements proximate the antenna **802** in such a way that the magnetic field is concentrated in a direction substantially pointing outside the host device. In some implementations, the core **810** may include a cylindrical ferrite core around which the antenna **802** of the transaction card **112** is wrapped. In some implementations, the core **810** may substantially reflect signals away from the transaction card circuitry, mobile device **110**, battery elements, and/or other elements that may be proximate to the transaction card **112** in such a way that the magnetic field is concentrated in a direction substantially pointing away from the host device. The antenna **802** may include a width in a range of 9 mm and a length in a range of 14 mm. The resilient member **804** may be rubber, foam, and/or other flexible material. As illustrated in FIG. **8**B, the antenna **802** is connected to a transaction circuit **810** (e.g., a contactless chipset) using, for example, a tuning circuit that tunes the antenna **802** to one or more frequencies. The one or more frequencies may be based, at least in part, on the terminal and/or type of terminal (e.g., POS **114**). For example, the tuning circuit may tune the antenna **702** to 13.56 MHz for ISO 14443 related transactions. The transaction card **112** may include an amplifier circuit **812** to amplify (e.g., a factor of 10) signals generated by the antenna **802**. In some implementations, the amplifier **812** may be of two types. For example, the amplifier **812** may be a passive amplifier that uses passive circuitry to amplify the RF signals received by the antenna (see FIGS. **13**A and **13**B) and/or a powered active amplifier that uses the energy from the battery of the host device to operate the transaction circuit (see FIG. **14**A and FIG. **14**B). In some implementations, the transaction card **112** may contain two additional RF interface pins **814***a* and **814***b* to allow the transaction card to use an external antenna, for example, an antenna contained in a separate housing for transactions and/or personalization.

FIGS. **9**A-**9**D illustrate an example transaction card **112** an antenna element **902** and a card element **904**. In the illustrated implementations, the card element **904** can be inserted into the antenna element **902** to form the transaction card **112**. The antenna element **902** may include an antenna **906** enclosed in a resilient member **908** as illustrated in FIG. **9**B and include antenna connections **910** for connecting the antenna **906** to the card element **904**. The card element **904** may include card connections **916** corresponding to the antenna connections **910** that connect to, for example, the contactless chipset. By selectively positioning the antenna element **902** and the card element **904**, the antenna connections **910** may abut the card connections **916** to form an electrical connection between the two elements. In addition to an electric connection, this connection may also provide a mechanical lock between the antenna element **902** and the card element. Once attached, the contactless chipset may be connected to the antenna **906** using a tuning circuit that tunes the antenna **906** to one or more frequencies for wireless communicating with, for example, the retail terminal **114**. For example, the tuning circuit may tune the antenna **906** to 13.56 MHz for ISO 14443 related transactions.

In some implementations, the card element **904** can include a width and a thickness the same or substantially the same as a standard MicroSD card such that at least a portion of the card element **904** may be inserted into a standard MicroSD slot. In some instances, the card element **904** may be 3-5 mm longer than a standard MicroSD card. The card element **904** may include a head protrusion that is slightly wider and/or thicker than a main body of the card element **904**. The antenna element **902** typically extends outside of the MicroSD slot after insertion of the card element **904**. In some implementations, the antenna element **902** may include a rounded curvature facing away from the slot during insertion and a flat surface on the other side. In some implementations, the antenna element **902** may form an opening having a width approximately 1-2 mm wide. The width of the opening may be approximately equal to the thickness of the main body of the card element **904**. In some implementations, the width of the opening may match the thickness of the head protrusion of the card element **904**. In the protrusion example, the thinner side of the card element **904** may be initially inserted into the antenna element **902**. In some implementations, the head protrusion of the card element **904** after insertion may be substantially flush with the opening. In this instance, the antenna element **902** and the card element **904** may form a cap with flat ends connected by a curvature. The antenna element **902** may be soft rubber, foam, and/or other material that may conform to portions of an SD slot during insertion of the card element **904**. The antenna **906** may be a flexible PCB including a thin copper antenna coil that is etched and/or mounted to form the antenna **906**. In some implementations, the card element **904** may include a notch **914** for receiving a portion of the antenna element **902** such as the protrusion **912**. In this case, the notch **914** and the protrusion **912** may substantially secure the card element **904** in the antenna element **902**.

FIGS. **10**A and **10**B illustrates another implementation of the transaction card **112**. In the illustrated implementation, the transaction card **112** includes an antenna element **1002** connected to a card element **1004**. The card element **1004** may include the same or substantially the same dimensions as a standard MicroSD card such that the card element **1004** may be inserted into an SD slot. The antenna element **1002** may be attached to a surface of, for example, a mobile device **110**. In the illustrated element, the antenna element **1002** includes a base **1005** affixed to a surface and configured to receive a pad **107**. For example, the base **1005** may be configured to secure the pad **107** adjacent a surface of the mobile device **110** as illustrated in FIG. **10**B. In some implementations, the base **1005** may include an adhesive plastic base including a detachable perforation **1006**. The pad **1007** may extend around a mobile device and attaches to the base **1005**. In some examples, the base **1005** and the pad **1007** may form a thin and flat sticker on the surface of the phone. The pad **1007** may include an antenna **1003**, a non-adhesive pad **1008**, and/or peripherals elements **1010**. The outside portion of the pad **1007** may include a plastic inlay enclosing the antenna **1003** of the transaction card **112**. The antenna **1003** may include copper coils etched on a very thin plastic film forming one of the layers of the inlay. The antenna **1003** may be connected to the contactless chipset of the card element **1004** using a connector **1012** (e.g., a flexible thin film) that wraps around the edge of the mobile device **110**. The connector **1012** may connect the antenna **1003** to the contactless chipset using a tuning circuit that tunes the antenna **1003** to one or more frequencies compatible with, for example, the retail terminal

114. For example, the tuning circuit may tune the antenna **1003** to 13.56 MHz for ISO 14443 related transactions. The base **1005** may include a ferrite material that substantially isolates RF analog signals and the magnetic field from the mobile device **110** (e.g., circuits, battery) in which case the connector may include additional connectivity wires than those used for antenna connection only. The pad **1007** may also contain another peripheral **1010** such as a fingerprint scanner connected to a corresponding logical element in the card element **1004** using the same connector **1014**.

FIGS. **11**A and **11**B illustrate an example transaction card **112** including a wireless connection between an antenna element **1102** and a card element **1104**. For example, the antenna element **1102** and the card element **1104** may include a wireless connection such as Bluetooth. The card element **1104** may include the same shape and dimensions as a standard MicroSD card such that the card element **1104** is substantially in an SD slot during insertion. The antenna element **1102** may be affixed to a surface of a device housing the card element **1104**. In some implementations, the antenna element **1102** can form a thin and flat sticker on the surface of the mobile device **110** as illustrated in FIG. **11**B. The antenna element **1102** may include a plastic inlay enclosing at least a portion of the antenna **1104**. The antenna **1104** may include a copper coil etched on a very thin plastic film forming one or more layers of the inlay. The antenna **1104** may connect to the card element **1104** (e.g., the contactless chipset) using a wireless pairing connection **1113** between a transceiver chip **1114** in the card element **1114** and a corresponding transceiver chip **1108** in the antenna element **1108**. The wireless connection **1113** may connect the antenna **1104** to the card element **1104** using a tuning circuit that tunes the antenna **1104** to one or more frequencies compatible with, for example, the retail terminal **114**. The wireless pairing connection used in this case may be in the high frequency spectrum (e.g., 900 Mhz, 2.4 GHz), which are unlicensed and free for use by domestic appliances, for example. For example, the tuning circuit may tune the antenna **1104** to 13.56 MHz for ISO 14443 related transactions. The antenna element **1102** may include a ferrite material that reflects wireless signals to substantially prevent interference with the mobile device **1110**. The antenna element **1102** may also contain another peripheral **1110** such as a fingerprint scanner wirelessly connected to a corresponding logical element in the card element using the same wireless connection **1113**.

FIGS. **12**A and **12**B illustrate example transaction cards **112** using a circuit board **1202** of a mobile device to receive and transmit wireless RF signals. Referring to FIG. **12**A, the transaction card **112** includes a plurality of connections **1210** to the circuit board **1202** to interface the mobile device **110**. Typically, the circuit board **1202** includes interconnecting copper wires that communicate digital signals. In some implementations, the circuit board **1202** may communicate analog signals in addition to the digital signals such as RF signals. In these instances, the transaction card **112** may include a frequency filter circuit **1206** to filter out RF signals (e.g., 13.56 MHz) transmitted by a retail terminal and received by the circuit board **1202**. In addition to receiving RF signals, the transaction card **112** may communicate an analog RF signal to the circuit board **1202** to transmit RF signals to the retail terminal. In some implementations, the transaction card **112** may contain two additional RF interface pins **1212***a* and **1212***b* to allow the transaction card to use an external antenna, for example, an antenna contained in a separate housing for personalization and/or transaction.

Referring to FIG. **12**B, the circuit board **1202** includes an external antenna **1214** that may be used by the transaction card **112**. In this case, the original SD interface PINS **1210** may be used for the sole purpose of standard SD host communication. The external antenna **1214** may be embedded in, affixed to or otherwise included on the board **1202**. The external antenna **1214** are connected to the pins **1216***a* and **1216***b* on the circuit board **1202** such that when the transaction card **112** is inserted into the mobile device the card **112** is connected to the external antenna **1214**. In some implementations, the pins **1212***a* and pins **1212***b* can connect to two the pins **1216***a* and **1216***b* on the handset circuit board **1202**, which are in turn connected to the antenna **1214** tuned to receive reader signals. The pins **1216** are positioned on the handset board **1202** such that upon insertion of, for example, the MicroSD in the phone, **1212***a* connects to **1216***a* and **1212***b* connects to **1216***b*. In these implementations, the transaction card **112** can exchange RF signals with the reader using the handset antenna **1214** and the pins **1212** and **1216**.

FIGS. **13**A-C illustrate example card elements **1300***a-c* for receiving transaction cards **110** in accordance with some implementations of the present disclosure. For example, the card element **1300** may amplify the range of the transaction card **112** of FIG. **1** using a larger antenna external. In some implementations, the card element **1300** may include one or more of the following advantages: extend wireless transaction ranges; enable personalization of the transaction card without modification of current personalization systems; can be mass produced; and/or others. In some instances, the card element **1300** may include an outer edge (see FIG. **15**B) that is compatible with current personalization machines. In other words, the transaction card **112** may be personalized using current personalization machines independent of modifying the physical operation of the personalization machines. In some instances, the card element **1300** may be mass produced using a few elements, as discussed with respect to FIGS. **15**A and **15**B.

In the illustrated implementations, the card element **1300** includes an antenna **1302**, a connector **1304** and an opening **1306** formed in a housing **1308** of the element **1300**. In some implementations, the card element **1300** may include a flexible material such as PVC, ABS, and/or other material. A transaction card **112** may be inserted into the opening **1306** to connect the card **112** to the antenna **1302**. In some implementations, the transaction card **112** may be substantially enclosed in the housing **1308** after insertion. In addition, the transaction card **112** may be inserted and removed multiple times to switch between using the transaction card **112** with the card element **1300** and using the card **112** with, for example, the mobile device **110**. In other words, the card elements **1300***a-c* may be designed such that after removing the card **112**, the card **112** can be re-inserted in and re-used with the card elements **1300**. In these instances, removing the card **112** from the card element **1300** may not permanently break their connection, which may be re-established after re-insertion.

As a result of engaging with the connector **1304**, the transaction card **112** may switch between from using an internal antenna enclosed in the card **112** to the external antenna **1302** enclosed in the card element **1300**. The larger, external antenna **1302** may increase the sensitivity when and/or range for executing wireless transactions with, for example, the POS **114**. In some implementations, the card element **1300** is substantially rectangular and includes one or more dimensions of a credit card in accordance with the ISO/IEC 7810 standard as ID-1. For example, the card element **1300** may be approximately 85.60×53.98 mm (3.370×2.125 in). In addition, the card system **130** may include one or more portions with a thickness of approximately 0.76 mm. In some implementations, the card element **1300** can include portions with varying thickness such as one portion with a thickness substantially equivalent to a credit card and another portion with a thickness of about equal to a thickness of an SD card (e.g., microSD card) or greater. For example, the card system **130** may include a portion with a thickness of about 0.76 mm and another portion with a thickness of at least about 1 mm.

Referring to FIG. **13**A, the card system **1302** includes a top surface **1310***a* and a side surface **1312***a* such that the opening **1306***a* is formed in the side surface **1312***a*. In this implementation, the transaction card **112** is inserted into the opening **1306***a* on the card element **1300***a* and connects to the connector **1304***a*. The card **112** may be oriented substantially parallel to the top surface **1310***a*. While the connector **1304** is illustrated as an SD PIN connector, the connector **1304** may be another connector without departing from the scope of this disclosure such as a proprietary connector, USB connector, and/or others. Referring to FIG. **13**B, the card element **1300***b* includes a top surface **1310***a*, a side surface **1312***b*, and a pocket element **1314**. The top surface **1310***a* and the pocket element **1314** form the opening **1306***b* for receiving the transaction card **112**. In this implementation, the card **112** can be inserted into the opening **1306***b* and connected to the connector **1304***b*. After insertion, the card **112** may be substantially parallel to the top surface **1310***b*. Referring to FIG. **13**C, the card element **1300***c* includes a top surface **1310***c* and a side surface **1312***c* substantially perpendicular to the top surface **1310***c*. In this implementation, the top surface **1310***c* forms an opening **1306***c* for receiving the transaction card **112**. After insertion, the card **112** may be connected to the antenna **1302***c* through the connector **1304***c* and may be substantially parallel to the top surface **1310***c* of the card element **1300***c*. In this implementation, the transaction card is retained in the opening **1306** using a friction fit and/or through the notches on each edge of the housing that holds the transaction card in place.

FIGS. **14**A-C illustrate two example portions **1400***a* and **1400***b* of a card element **1300** in FIG. **13**. In this implementation, the portion **1400***a* includes a bottom element **1402** that forms a recess **1404** to receive the antenna **1302**. For example, the bottom element **1402** may be a plastic molded to include the recess **1404**. In other words, the bottom element **1402** may include a cavity **1404** for receiving the antenna **1302**. In connection with placement, the antenna **1302** is connected to antenna pins **1410** through a multiplexer **1408**. The multiplexer **1408** switches the antenna connection of the transaction card **112** to between an internal antenna and the external antenna **1302**. While illustrated as external to the transaction card **112**, the multiplexer **1408** may be included in the card **112** without departing from the scope of this disclosure. The antenna pins **1410** may be pins associated with a standard SD configuration such as the outer pins. In some implementations, the transaction card **112** includes pins that are not in accordance with the standard SD configuration as illustration by connector pins **1410***b*. For example, the transaction card **112** and the corresponding card element **1400** may include extra contacts for connecting to the antenna **1302** as illustrated in FIG. **14**B. In FIG. **14**C, the transaction card **112** houses, encloses, or otherwise includes the multiplexer **1408***c*. For example, the multiplexer **1408***c* may be enclosed in the housing of the transaction card **112** as compared to being enclosed in the card element **1300** as illustrated in FIGS. **14**B and C. In some implementations, the card element **1300** may solely include the antenna **1302** and SD PIN connectors **1304**. The transaction card **112** may use the multiplexer **1408***c* to selectively switch between the internal antenna and the antenna **1302** included in the card element

1300. In these instances, the transaction card **112** may execute wireless transactions independent of external processing devices such as independent of devices included in the card element **1300** (e.g., receiver, transmitter, multiplexer)

FIGS. **15**A and **15**B illustrate example profiles **500** and **520** of a card element **1300** in accordance with some implementations of the present disclosure. In this implementation, the profiles **500** and **520** illustrate side views of the card element **1300** before and after bonding two card elements. Referring to FIG. **15**A, the profile **1500** illustrates a top element **1502** and a bottom element **1504**. For example, the bottom element **1504** may be a side view of the bottom element **1402** illustrated in FIG. **14**A or **14**B. As illustrated, the bottom element **1504** forms a recess or cavity that receives the top element **1502** prior to affixment. Referring to FIG. **15**B, the profile **1520** illustrates a side view of the top element **1502** affixed to the bottom element **1504** to form, for example, the card element **1300**. For example, the top element **1502** and the bottom element **1504** may fused together using, for example, heat. Regardless, the affixed elements **1300** include a first portion **1524** with a first thickness indicated by th_1 and a second portion **1526** with a second thickness indicated by th_2. In some implementations, the first thickness may be approximately a width of a credit card such as, for example, 0.76 mm and/or other widths that comply with standards such as ISO 7810, ID1 and CR80. In some implementations, the second thickness may be at least a thickness of an SD card such as, for example, between about 1 mm and 2.1 mm. In addition, the affixed elements **1300** include a first width (w_1) indicating a width of the card element **1300**, a second width (w_2) indicating a width of the second portion **1526**, and a third width (w_3) indicating a width associated a portion **1524** used during the personalization process. In some implementations, the first width may be approximately the same width as a standard credit card in accordance with ISO/IEC 7810 standard. In some implementations, the second width may be at least a width of a microSD card such as, for example, about 11 mm, 20 mm, or 24 mm. The third width may be sufficient to personalize the transaction card **112** using standard personalization machines when inserted into the card element **1300**. In some implementations, the third width may be sufficient to receive a mag stripe such as about 9.52 mm. In addition, the third width may be sufficient for graphical personalization such as embossing an account number, name, and expiration date. In these instances, the third width may be sufficient to affix a mag stripe, a signature strip, and/or printing characters. In some implementations, the outer edge identified by w_3 may be compatible with current personalization without requiring physical modification. To ensure physical compatibility, width w_3 may not be equal to $w_1-(w_2+w_3)$ as the width required by the magnetic stripe (w_3) may be wider than the width required for simply holding the card as it passes through the personalization system.

FIGS. **16**A-C illustrate different views of the card system **1600** for executing financial transactions. For example, the card system **1600** may execute wireless transactions as well as contact transactions (e.g., magnetic stripe). In this implementation, the card system **1600** includes a card element **1300** and a transaction card **112** inserted into the card element **1300**. The card element **1300** may include one or more elements associated with a credit card or debit card. For example, the card element **1300** may be embossed with an account number **1606**, an expiration date **1608**, an account holder's name **1610**, and/or other information. In addition, the card element **1300** may include a logo **1612** to identify a type of account (e.g., Visa, MasterCard). In the illustrated implementation, the card element **1300** forms an opening that receives the transaction card **112**. The card element **1300** may enclose or otherwise include an antenna (not illustrated) that connects to the transaction card **1604** during insertion. As illustrated in FIG. **16**B, the card element **1300** may include a magnetic strip **1614** for executing contact transactions. For example, POS devices that include magnetic readers may determine information encoded on the magnetic stripe **1614** to execute transactions. The magnetic stripe may at least identify one or more of the following: card holder name, card holder account number, expiry date, and/or other information.

FIG. **17** is a flow chart illustrating an example method for manufacturing card elements **1300** of FIG. **13**. In general, the card element **1300** is manufactured by affixing two elements together to form an opening to receive a transaction card **112** and connect to an enclosed antenna **1302**. Many of the steps in this flowchart may take place simultaneously and/or in different orders as shown. The system **100** may use methods with additional steps, fewer steps, and/or different steps, so long as the methods remain appropriate.

Method **1700** begins at step **1702** wherein a first card element is identified. For example, the card element **1402** may be identified. At step **1704**, a connector is selectively position in the first card element. In the example, the connector **1304** may be selectively positioned in the bottom card element **1402**. Next, at step **1706**, an antenna is selectively positioned in the first card element. As for the example, the antenna **1302** may be selectively positioned in the bottom card element **1402**. The antenna and the connector are connected at step **1708**. Again in the example, the connector **1304** may be connected (e.g., soldered) to the antenna **1302**. At step **1710**, a second card element s selectively positioned to overlap at least a portion of the first card element. Returning to the example, the top card element **502** may be positioned over the bottom card element **1402** to form an opening **1306** and enclose the antenna **1302** and the connector **1304**. Next, at step **1712**, the first card element is affixed to the second card element. In the example, the bottom card element **1402** and the top card element **1502** may be fused or otherwise affixed to form the card element **1300**.

FIGS. **18**A-C illustrate different views of a card system **1800** that executes both contactless and contact payments. For example, the card system **1800** may execute wireless transactions as well as contact transactions using, for example, a smart card interface **1802**. Generally, a card including a smart card interface may be inserted into a smart card terminal such that the terminal forms electrical connections with the interface. In the illustrated implementations, the smart card interface **1802** is connected, through the electrical connections **1806***a-f*, to a smart-card module **1804** in the transaction card **112**. The electrical connections **1806***a-f* are enclosed in the card element **1300** and are connected to the connectors **1304**. In these examples, the transaction card **112** connects to the interface **1802** during insertion. The card system **1800** may include dimensions in accordance with the ID-1 of ISO/IEC 7810 standard that defines them as 85.60×53.98 mm. Some card systems **180** may have dimensions according to ID-000 which is 25×15 mm (commonly used in SIM cards). Both standards are 0.76 mm thick. Referring to FIG. **18**B, the card element **1300** includes a portion **1810** with a first width smaller than a second width for a second portion **1812**. In some implementations, the first width may be about 0.76 mm thick. In these instances, the first portion **1810** may be inserted in smart-card terminals, ATMs, and/or other terminals to execute contact transactions. The transaction card **112** may communicate with the terminals using the interface **1802** and the connections **1806***a-f*.

As previously discussed, the card system **1800** may include one or more elements associated with a credit card, debit card, prepaid card, and/or a gift card. For example, the card element **1300** may be embossed with an account number **1606**, an expiration date **1608**, an account holder's name **1610**, and/or other information (see FIGS. **16**A-C). In addition, the card element **1300** may include a logo **1612** to identify a type of account (e.g., Visa, MasterCard). In the illustrated implementation, the card element **1300** forms an opening that receives the transaction card **112**. The card element **1300** may enclose or otherwise include an antenna (not illustrated) that connects to the transaction card **112** during insertion. As illustrated in FIG. **18**C, the card system **1800** may include a magnetic strip **1808** for executing contact transactions. In some implementations, the card system **1800** may execute two different types of contact transactions such as transactions using the magnetic stripe **1808** and transactions using the smart-card interface **1802**.

FIG. **19** is a flow chart illustrating an example method **1900** for personalizing card systems. For example, the method **1900** may personalize both the transaction card **112** and the card element **1300**. In general, the card system is manufactured, personalized, fulfilled, and delivered to the user. Many of the steps in this flowchart may take place simultaneously and/or in different orders as shown. The system **100** may use methods with additional steps, fewer steps, and/or different steps, so long as the methods remain appropriate.

To begin with, the method **1900** includes four main processes: (1) manufacturing from steps **1902** to **1906**; (2) personalization from steps **1908** to **1916**; (3) fulfillment from steps **1918** to **1920**; and (4) delivery at step **1922**. As for the manufacturing process, the method **1900** includes step **1902** where the transaction card and the card element are manufactured. For example, the transaction card **112** and the card element **1300** may be manufactured separately. At step **1904**, software is loaded on the transaction card such as firmware for executing wireless transactions and/or other modules previous discussed. While the method indicates the software is loaded during the manufacturing process, the software may be loaded during the other processes such as, for example, the personalization process. For example, parts of the software may be loaded during the manufacturing process (e.g., OS, application) and parts of the software may be loaded during the personalization process (e.g., batch-specific parts, bank-specific customization). Next, at step **1906**, the transaction card and the card element are assembled. In the example, the transaction card **112** may be inserted in, snapped into, or otherwise connected to the card element **1300**. Turning to the personalization process, the card system enters the personalization system at step **1908**. At step **1909**, bank-associated software is loaded on the transaction card such as, for example, a bank user interface. The card is electronically personalized at step **1910**, where electrical personalization may include the payment application and the user credentials. As for the example, the transaction card **112** may be uploaded with personal information, payment applications as well as other information associated with the user. Next, at step **1912**, the magnetic stripe on the card element may be magnetically personalized. Again in the example, the mag stripe **1614** may be encoded with an account number, a user name, expiration date and/or other information. The card element is graphically personalized at step **1914**. In the example, the card element **1300** may be embossed with the name, account number, expiration date and/or information associated with the associated financial account. The card system leaves the personalization system at step **1916** and enters the fulfillment system at step **1918**. At step **1920**, the card system is packaged with materials from the associated institution such as instructions, coupons, and/or other materials. Next, at step **1922**, the card system is mailed to the user, which includes a plurality of different implementations, For example, the card system **1800** may be used by the user using a contactless interface, a mag stripe, and/or a smart-card interface, and may be inserted into a mobile device for wireless transactions.

A number of embodiments of the invention have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, other embodiments are within the scope of the following claims.

What is claimed is:

1. A transaction card, comprising:

a substantially-rectangular housing enclosing at least a portion of a first antenna and at least a portion of a connector and forming an opening for receiving a transaction device, including a second antenna, configured to wirelessly execute transactions within a first range;

the connector connected to the first antenna and configured to physically connect the transaction device to the first antenna when inserted into the opening formed by the housing, wherein the transaction device wirelessly communicates directly using the first antenna through the connector;

the first antenna configured to enable the transaction card to wirelessly execute, when inserted into the transaction card, transactions within a second range larger than the first range;

a magnetic stripe adjacent a surface of the housing and encoding information for executing contact transactions with transaction terminals; and

wherein the transaction device comprises one or more processors operable to:

connect to an expansion slot of a mobile host device;

communicate with a user through a Graphical User Interface (GUI) of the mobile host device and with a service provider through wireless technology of the mobile host device;

store user credentials used to execute transactions with terminals;

execute a transaction application using the user credentials;

wirelessly receive a transaction request from a terminal; and

wirelessly transmit at least one transaction response to the terminal based on results of the executed transaction application.

2. The transaction card of claim **1**, the housing includes dimensions in accordance with International Organization for Standardization ISO/IEC 7810 standard.

3. The transaction card of claim **1**, the housing includes a first portion with a first thickness and a second portion with a second thickness different from the first thickness and at least the thickness of the transaction device, the second thickness is at least approximately 1 mm, approximately 1.4 mm, or approximately 2.1 mm.

4. The transaction card of claim **3**, the housing comprising a length and the second thickness extending in a direction substantially parallel to the length of the housing.

5. The transaction card of claim **1**, the housing including a plurality of raised portions identifying a string associated with a financial account.

6. The transaction card of claim **1**, the housing including a top surface and a bottom surface that are substantially rectangular and a side surface that forms the opening to receive the transaction device.

7. The transaction card of claim **1**, the housing including a top surface and a bottom surface that are substantially rectangular, the top surface forms the opening to receive the transaction device.

8. The transaction card of claim **1**, the transaction device is a Securepigital (SD) card, MicroSD card, MiniSD card, or a Universal Serial Bus (USB) dongle.

9. The transaction card of claim **1**, the housing including a substantially-planar interior surface, the antenna includes a coiled antenna adjacent the substantially-planar interior surface.

10. The transaction card of claim **1**, further comprising a smart-card contact pad affixed to the housing and connected to the connector, the transaction device connected to the smart-card contact pad during insertion and configured to execute a contact transaction with smart-card terminals.

11. The transaction card of claim **1**, when inserted into a mobile phone device, the transaction device configured to execute transactions with RF enabled terminals using RF signals transmitted in accordance with contactless standards ISO 14443 Type A and Type B, MiFare, RFID, Felica, NFC, ISO 15693, or Bluetooth.

12. The transaction card of claim **1**, the user credentials associated with one of a credit card account, a checking account, a debit account, a gift account, or a prepaid account.

13. The transaction card of claim **1**, wherein the one or more processors are further configured to:

generate the transaction response based, at least in part, on the user credentials and the transaction application; and

execute an operating system with a runtime environment that executes the transaction application.

14. The transaction card of claim **13**, the operating system loaded on the processing module during a manufacturing process, the security module loaded on the processing module during a personalization process different from the manufacturing process.

15. The transaction card of claim **1**, wherein a same user credentials are used by magnetic-strip transactions, contactless transactions after insertion in the housing, smart-card transactions after insertion in the housing, and mobile-device transactions after insertion in a mobile device.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

Page 1 of 1

PATENT NO.	: 9,195,931 B2
APPLICATION NO.	: 13/302766
DATED	: November 24, 2015
INVENTOR(S)	: Deepak Jain et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the claims,

In Column 33, In Line 6, In Claim 8, delete “Securepigital” and insert -- SecureDigital --, thereof.

Signed and Sealed this
Twenty-second Day of March, 2016

Michelle K. Lee

Michelle K. Lee
Director of the United States Patent and Trademark Office